STATEMENT OF WORK
REMEDIAL INVESTIGATION/FEASIBILITY STUDY
CABO ROJO GROUND WATER CONTAMINATION SITE, CABO ROJO, PUERTO RICO

Introduction

This statement of work describes the Government's requirements for performance of a Remedial Investigation and Feasibility Study (RI/FS) to investigate the overall nature and extent of contamination and develop remedial alternatives at the Cabo Rojo Ground Water Contamination Site, ("the Site"), thereafter, Cabo Rojo Site. The contractor shall perform this RI/FS pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, as amended (CERCLA), and the Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (U.S. Environmental Protection Agency, October 1998).

The Remedial Investigation will characterize the nature and extent of the risks associated with the contamination at the site, and includes (1) collection of data and information necessary to characterize the nature and extent of contamination at the site and assess the risk to human health and the environment, and (2) a determination of whether the contamination presents a significant risk to human health or the environment. The Feasibility Study will develop and analyze a range of remedial action alternatives through the application of established evaluation criteria, to facilitate selection of the remedy.

Site Description

The Cabo Rojo site consists of a ground water plume with no identified source(s) of contamination located in the municipality of Cabo Rojo, Puerto Rico. Samples collected from the Ana Maria, Club de Leones, and Hacienda la Margarita wells indicated detections of tetrachloroethylene (PCE) and trichloroethylene (TCE) below MCLs. Throughout the years, PRASA has voluntarily closed other wells in the area after chlorinated solvents have been detected in wells such as: Terminal Carros Publicos, Cabo Rojo 8, and McDougal (aka. Cabo Rojo 5). Weko 1 and Weko 2 drinking water wells were allegedly closed due to mercury and arsenic contamination.

Ground water exists in the alluvium aquifer under water-table conditions recharging the underlying bedrock. Geologic cross-sections for the Cabo Rojo region published by the U.S. Geological Survey (USGS), confirm that there is not a continuous confining layer separating the alluvial valley aquifer and the bedrock aquifer within 2 miles of the ground water plume; therefore, the alluvium and bedrock aquifers are considered as one hydrogeologic unit. The vertical sequence of stratigraphic units within the Guanajibo Valley includes unconsolidated alluvial (sand, gravel, and clayey sand) and marginal marine deposits underlain by limestone and volcaniclastic igneous bedrock. The transmissivity associated with the Ana Maria well is 1,400 square feet per day (ft^2/day) and the transmissivity of the Club de Leones well is 1,300 ft^2/day. The hydraulic conductivity associated with the Ana Maria well is 3.08 x 10^{-3} centimeters per second (cm/sec) and the hydraulic conductivity associated with the Club de Leones well is 7.64 x 10^{-3} cm/sec. PRASA supply wells associated with the Cabo Rojo Ground Water Contamination site (i.e., Ana Maria, Club de Leones, Cabo Rojo 2, and Cabo Rojo 3) are finished in the bedrock aquifer. The hydraulic conductivity of the limestone and volcaniclastic igneous bedrock are similar. The direction of ground water flow in the vicinity of the site is influenced by a cone of depression toward public supply wells (i.e., Cabo Rojo 2, Cabo Rojo 3, and Club de Leones) located in the vicinity of the low-lying Cienaga de Cuevas/Bajura area. Bottom elevations of the wells range from 143 to 236 feet above mean sea level (AMSL), and the screened intervals presented range in elevation from 33 to 236 feet AMSL; however the pump depths for the wells are similar (133-149 feet AMSL). The interconnected water supply system consisting of Hacienda la Margarita, Cabo Rojo 1, Cabo Rojo 2, Cabo Rojo 3, and Club de Leones serve an estimated population of 45,055 people. The Ana Maria well acts as an independent system which serves approximately 1,856 persons. GW occurs in limestone formations underlying alluvium and in sand and gravel lenses w/I the alluvium. The thickness of the alluvium is approximately 70 ft. The volcanic bedrock lies about 500 feet below ground surface. The drinking water wells are between 80-110 feet deep.

In 2006, EPA conducted site reconnaissance activities at 68 facilities in Cabo Rojo, identifying 12 facilities for further investigation. Although chlorinated solvents (i.e., PCE, TCE, cis-1,2-DCE, trans-1,2-dichloroethylene

[trans-1,2-DCE], and vinyl chloride) were detected at three of the 12 facilities investigated, EPA did not identify the source of ground water contamination in the public supply wells as the contamination was not detected in both a source and ground water release at two of the facilities, and a connection between a release at the third facility and the ground water plume impacting the public wells could not be established. Based on these results, there is insufficient information to determine conclusively the source of contamination of the local drinking water supply wells.

Purpose

The purpose of this statement of work (SOW) is to describe the requirements for conducting a Remedial Investigation/Feasibility Study (RI/FS) to select a remedy to eliminate, reduce, or control risks to human health and the environment at Cabo Rojo Ground Water Contamination site ("Cabo Rojo Site"). This SOW is designed to provide the framework for conducting the RI/FS activities at the site. The objective of this RI/FS is to review and evaluate the studies and investigations performed at the site to date, determine the minimum amount of sampling data necessary to complete characterization of the site and support the selection of an approach for site remediation, and to use this data in support of a Record of Decision (ROD) within approximately twenty seven months after approval of the work plan. The estimated completion date for this work assignment is September 30, 2013.

General Requirements

The contractor shall perform the RI/FS in accordance with this SOW and all other relevant guidance used by EPA in conducting an RI/FS. The contractor shall furnish all necessary and appropriate personnel, materials, and services needed for, or incidental to, performing and completing the RI/FS. In all cases, the contractor shall use the most recently issued guidance.

Attachment 1 of this SOW is a summary and prospective schedule for submittal of the major deliverables. A final schedule for submittal of these deliverables will be established as part of the approved work plan for this RI/FS.

EPA will monitor and oversee contractor activities throughout the RI/FS. EPA will review all deliverables prior to acceptance to determine whether the performance requirements of this work assignment have been met, and to assess the likelihood that the RI/FS will achieve its goals. Acceptance of deliverables by EPA does not relieve the contractor of responsibility for the adequacy of the deliverables in accordance with contract requirements.

The contractor shall communicate at least weekly with the Work Assignment Manager (WAM), either in face-to-face meetings or through conference calls. The contractor shall notify EPA when 75 percent of the expenditure limit has been expended, and provide a project estimate at completion, in accordance with Clause B.9, "Special Limitation of Cost Provision for Work Assignments."

Green Remediation

"Green Remediation" is the practice of considering all environmental effects of the implementation of a remedy and incorporating options to maximize the net environmental benefit of cleanup actions. In accordance with EPA's strategic plan for compliance and environmental stewardship, the Agency strives for cleanup programs that use natural resources and energy efficiently, reduce negative impacts on the environment, minimize or eliminate pollution at its source, and reduce waste to the maximum extent possible. The EPA Region 2 Superfund program supports the adoption of "green site assessment and remediation," which is defined as the practice of considering all environmental impacts of studies, selecting and implementing a given remedy, and incorporating strategies to maximize the net environmental benefit of cleanup actions (see http://www.clu-in.org/greenremediation).

On March 17, 2009, Region 2 established a "Clean & Green" policy to enhance the environmental benefits of Superfund cleanups by promoting technologies and practices that are sustainable. This policy applies to all Superfund cleanup projects, and is available at http://www.epa.gov/region02/superfund/green_remediation/policy.html. Region 2's "Clean and Green Policy" calls for the contractor, at a minimum, to purchase 100 percent of the electricity for this project from renewable sources

and use clean diesel fuels and technologies during the performance of this work assignment. Under this policy, certain green remediation technologies will serve as touchstones for Region 2 response actions. The Region 2 "touchstone technologies" include:

Use of 100% of electricity from renewable sources http://www.epa.gov/osw/partnerships/c2p2/index.htm
Concrete made with Coal Combustion Products (CCP) replacing a portion of traditional cement
Clean diesel fuels and technologies http://www.epa.gov/lmop/overview.htm - methane
Methane capture at landfill sites
http://apps3.eere.energy.gov/greenpower/buying/buying_power.shtml
http://www.epa.gov/oms/retrofit/nonroad-list.htm

To the extent practicable, the contractor shall explore and implement green remediation strategies and applications in the performance of the requirements of this work assignment to maximize sustainability, reduce energy and water usage, promote carbon neutrality, promote industrial materials reuse and recycling, and protect and preserve land resources. The contractor shall present green remediation options and approaches in its work plans, provide cost analyses for these options in its work plan budgets, maintain records of "green-related" activities, and report this information to EPA in its monthly progress reports or as requested by the Project Officer.

The following guidance documents provide additional information regarding the implementation of "Green Remediation" practices:

- Attachment 2, "Green Remediation Practices"
- Federal Acquisition Regulation, Part 23, "Environment, Energy and Water Efficiency, Renewable Energy Technologies, Occupational Safety, and Drug-Free Workplace:" FAR Subparts 23.2, 23.4, 23.7, and 23.8 (see http://www.arnet.gov/far/05-23-1/html/FARTOCP23.html)
- Executive Order 13423, "Strengthening Federal Environmental, Energy, and Transportation Management" (January 2007) (see http://www.epa.gov/oaintrnt/practices/eo13423.htm)

Electronic Data Deliverable (EDD) Requirements

Region 2 has adopted the standardized electronic data deliverable (EDD) format in order to streamline the electronic submittal of environmental sampling data. The EDD format is required for all new and historic data submitted to the Region. The contractor shall provide electronic submittal of field sampling and laboratory analytical results, geologic data, and well location data in accordance with Region 2's policies, guidelines, and formats.

Region 2's "Comprehensive Electronic Data Deliverable Specification Manual 1.4" (July 2009) explains the systematic implementation of EDD within Region 2, and provides detailed instructions of data preparation and identification of data fields required for data submissions. Additional Region 2 EDD guidance and requirements documents, including the "Electronic Data Deliverables Valid Values Reference Manual" and tables, the "Basic Manual for Historic Electronic Data," the "Standalone EQuIS Data Processor User Guide," and EDD templates, can be found at http://www.epa.gov/region02/superfund/medd.htm.

EPA Primary Contact

The primary contact for this work assignment is Denise Zeno, the Work Assignment Manager (WAM). He can be reached at 212.637.4319, via fax at 212.637.3083 or via the Internet at zeno.deniseo@epa.gov. The secondary contact is Helen Eng, the Deputy Project Officer. She can be reached at phone number 212.637.4348, by fax at 212.637.3083, or by e-mail at eng.helen@epa.gov.

Record-Keeping Requirements

The contractor shall maintain all technical and financial records for this RI/FS work assignment in accordance with the requirements of this contract and the technical direction of the EPA WAM. These technical and financial records must be in sufficient detail to support decisions made during the RI/FS as well as cost recovery actions. At the completion of the RI/FS, the contractor shall submit one copy of the major deliverables in electronic format (Word, Excel, and/or PDF, as applicable) to the EPA WAM, with one copy to the EPA Records Manager, pursuant to the requirements of Clause D.1, "Electronic Submission of Deliverables."

Project Closeout

At the completion of this work assignment, the contractor shall perform all necessary project closeout activities as specified in the contract. These activities shall include closing out subcontracts, indexing and consolidating project records and files and providing a technical and financial closeout report to EPA. Final costs shall be reported to EPA in electronic format, broken down by cost element for each subtask of the Work Breakdown Structure (WBS) identified in this SOW.

Task 1 Project Planning and Support

1.1 Project Administration

The contractor shall provide the following project administration support in the performance of this work assignment:

Contractor site manager (SM) activities under project administration shall include:

Preparation of the technical monthly progress report
Review of weekly financial reports
Review and update project schedule
Weekly communication with EPA WAM
Prepare staffing plans

Program support personnel activities under project administration shall include:

Preparation of work assignment technical/financial status reports for the monthly progress report
Technical resource management
Review of work assignment budget status
Respond to questions from the EPA PO and CO
Preparation of monthly invoices

1.2 Scoping Meeting

The contractor shall attend a scoping meeting to be held at the EPA Region 2 office in New York. This scoping meeting will cover the RI/FS requirements. The requirements, level of effort, and costs for this work will be performed and accounted for under this work assignment.

The scoping meeting will be held within 30 calendar days after the issuance of this work assignment. It is anticipated that 2 - 3 contractor personnel will attend the scoping meeting. The contractor shall contact the EPA WAM within 5 calendar days after receipt of this work assignment to schedule the scoping meeting. The contractor shall prepare meeting minutes, which shall include the contractors understanding of all agreements reached and any issues requiring resolution, for review by the EPA WAM, PO and CO.

1.3 Conduct Site Visit

The contractor shall conduct a 1-day site visit during the project planning phase to develop a conceptual understanding of the site and the RI/FS scope and requirements. It is anticipated that 2 contractor personnel will

attend the site visit.

1.4 Develop Draft Work Plan and Associated Cost Estimate

The contractor shall prepare and submit a draft RI/FS work plan and budget in accordance with contract requirements. The contractor shall use information from the appropriate EPA guidance referenced in this SOW and technical direction provided by the EPA WAM (per Clause H.19) as the basis for preparing the work plan and budget. General requirements for preparation of work plans and work plan budgets are described in Section 8.0 of Attachment B, Reports of Work."

The RI/FS work plan shall include a comprehensive description of project tasks, the procedures to accomplish them, project documentation, and a proposed project schedule. The contractor shall use its approved quality assurance/quality control (QA/QC) systems and procedures to assure that the work plan and other deliverables are of professional quality. The work plan shall include the following:

- Identification of RI/FS project elements including planning and activity reporting, field sampling and analysis, and treatability study activities. The contractor shall implement a detailed work breakdown structure for the RI/FS in accordance with the work breakdown structure in this statement of work.

- The contractor's technical approach to each task to be performed, including a detailed description of each task; the assumptions used; any information to be produced during and at the conclusion of each task; and a description of the work products that will be submitted to EPA. Information shall be presented in a sequence consistent with this SOW.

- A proposed schedule showing specific dates for completion of each required activity and submission of each deliverable required by this SOW. This schedule shall also include information regarding timing, initiation, and completion of all critical path milestones for each activity and deliverable and the anticipated review time for EPA.

- Address site access, security, contingency procedures, management responsibilities and how investigation-derived wastes (IDW) are to stored and disposed of.

- A list of key contractor personnel providing support on the work assignment.

In conjunction with preparation of the draft work plan, the contractor shall prepare and submit a draft work plan budget. This work plan budget shall follow the work breakdown structure for this assignment as indicated in the statement of work, and shall contain a detailed cost breakdown, by subtask, of the direct labor costs, subcontract costs, "other direct" costs, projected base fee and award fee pool, and any additional specific cost elements required for performance of each of the subtasks under this statement of work. "Other direct" costs shall be broken down into individual cost categories as required for this work assignment, based on the specific cost categories negotiated for this contract. The work plan budget shall contain a detailed rationale describing the contractor's assumptions for estimating the level of effort (including professional/technical levels and skill mix), subcontract amounts, and "other direct" cost amounts for each subtask under this SOW.

1.5 Negotiate and Prepare Final Work Plan/Budget

The contractor shall participate in a work plan negotiation meeting at the Region 2 New York office in person or via tele-conference. EPA and the contractor will discuss and negotiate the costs required to accomplish the tasks described in the final work plan implementing the requirements of this SOW. The contractor shall submit a final work plan incorporating all EPA review comments and a final work plan budget incorporating the agreements made in the negotiations. The final work plan budget shall include a summary of the negotiations. The contractor shall submit the revised work plan and budget in both hardcopy and electronic formats.

1.6 Evaluate Existing Data and Documents

The contractor shall research and review available background information and documentation pertaining to the site, including all studies and investigations performed at the site, as provided or identified by the EPA WAM. As part of this effort, the contractor shall evaluate the following documents:

- EPA files and records.
- Files and records from the U.S. Geological Survey, Army Corps of Engineers, and other Federal sources.
- File and record from Commonwealth sources such as the PREQB files and records.
- PRP files and records (if available).

1.7 Quality Assurance Project Plan

The contractor shall prepare a Quality Assurance Project Plan (QAPP) in accordance with the "EPA Requirements for Quality Assurance Project Plans (EPA QA/R-5)" (EPA/240/B-01/003, March 2001; reissued May 2006), the "Uniform Federal Policy for Quality Assurance Project Plans" (EPA-505-B-04-900A, March 2005), current EPA Region 2 RAC QAPP guidance and procedures, and the contractor's current approved quality management plan for this contract. The QAPP shall be submitted as an appendix to the RI/FS work plan to facilitate review and approval.

The QAPP is a comprehensive document combining information previously provided under two separate documents, the Quality Assurance Project Plan (QAPP) and the Sampling and Analysis Plan (SAMP). The QAPP shall describe the project objectives and organization, functional activities, and quality assurance/quality control (QA/QC) protocols that will be used to achieve the desired Data Quality Objectives (DQOs). The DQOs shall, at a minimum, reflect use of analytical methods for identifying and addressing contamination consistent with the levels for remedial action objectives identified in the National Contingency Plan.

In addition, the QAPP shall describe the number, type, and location of samples and type of analyses to be performed. The QAPP shall include sampling objectives, sample locations and frequency, sampling equipment and procedures, sample handling and analysis, and a breakdown of samples to be analyzed through the Contract Laboratory Program (CLP) and other sources, as well as the justification for these decisions. The QAPP shall consider the use of all existing data and shall justify the need for additional data whenever existing data will meet the same objective. The QAPP shall be written so that a field sampling team unfamiliar with the site would be able to gather the necessary samples and field information in accordance with EPA Region 2's quality assurance requirements. The contractor shall document any required changes to the QAPP in a letter to the EPA WAM and QAO.

1.8 Health and Safety Plan

The contractor shall prepare a site-specific Health and Safety Plan (HASP) that specifies employee training, protective equipment, medical surveillance requirements, standard operating procedures and a contingency plan in accordance with 40 CFR 300.150 of the NCP and 29 CFR 1910.120 (l)(1) and (l)(2). The HASP shall be submitted as an appendix to the work plan to facilitate document review and approval.

1.9 Non-RAS Analyses

At the direction of EPA, the contractor shall develop an EPA-approved laboratory quality assurance program that provides oversight of in-house and subcontracted laboratories through periodic performance evaluation sample analyses and/or on-site audits of operations, and prescribes a system of corrective actions to be implemented in cases where the laboratory's performance does not meet the standards of this program. This will include at a minimum:

- Prepare Laboratory Services Requests (e.g., statements of work) for all non-RAS parameters. The Laboratory Services Request(s) shall include the following elements:

  -digestion/analytical methods
  -data deliverable requirements
  -quality control (QC) requirements

-estimated number of samples
-method restrictions and penalties for non-compliance
-turnaround times

- Develop QC criteria for each parameter of the approved site-specific or contract-wide QAPP that will be incorporated into the Laboratory Service Request.

- The contractor shall comply with all applicable and appropriate requirements in the acquisition and management of subcontracts for analytical services, including the requirements, terms, and conditions of this contract; the subcontractor's corporate standard operating procedures; and the applicable requirements of the Federal Acquisition Regulation (FAR), Environmental Protection Agency Acquisition Regulation (EPAAR), and other relevant Federal and Agency acquisition requirements.

- At the request of the EPA WAM, the contractor shall submit the Laboratory Services Request for EPA review prior to solicitation of an analytical services subcontract.

1.10 Meetings

The contractor shall participate in progress meetings during the course of the work assignment. For budgeting purposes, the contractor shall assume 8 meetings, with 2 people in attendance. The contractor shall prepare minutes of each meeting for review by the EPA WAM.

1.11 Subcontract Procurement

The contractor shall identify, solicit, and award the subcontracts necessary to perform the requirements of this statement of work. The contractor shall describe the subcontracts needed for this RI/FS as part of its work plan and budget. All subcontract procurement activities shall be performed under this subtask.

1.12 Perform Subcontract Management

The contractor shall perform management and oversight of any subcontract(s) needed for RI/FS activities. The contractor shall institute procedures to monitor progress, and maintain systems and records to ensure that the work proceeds in accordance with the requirements of this work assignment and the contract. The contractor shall review and approve subcontractors' invoices and issue any necessary subcontract modifications.

1.13 Pathway Analysis Report (PAR)

The contractor shall prepare a Pathway Analysis Report in accordance with the "Risk Assessment Guidance for Superfund: Part D," dated December 2001. The PAR shall be submitted after the draft work plan is approved; the specific schedule for submission of the PAR will be established as part of final work plan approval. The PAR must be reviewed and approved by EPA prior to submission of the draft risk assessment report.

The PAR shall describe the risk characterization process and how the risk assessment will be prepared, in order to allow the risk assessors to ensure that the proper guidance and methodologies are followed. This report shall contain all of the information necessary for a reviewer to understand how the risks at the site will be addressed, including the statistical treatment of the data, the methods for selection of the contaminants of potential concern (COPCs), the exposure pathways, receptors and parameters to be used, and the current toxicological values. The report shall include the RAGS, Part D Tables 1 through 6, as well as explanatory text, based on all data collected. The PAR shall be completed after all data are collected, in accordance with the requirements of RAGS, Part D Tables 1 through 6. If the contractor recommends modeling, a description of the model and an explanation of the inputs and assumptions shall be included in the PAR so that their appropriateness can be determined (see also Subtask 6.3). The results shall be provided in the draft human health risk assessment under Subtask 7.1.

Task 2 Community Relations

This task covers technical support to be provided by the contractor during public meetings and availability sessions conducted under this work assignment. The contractor shall provide community relations support to EPA throughout this RI/FS assignment in accordance with the *"Superfund Community Involvement Handbook"* (EPA 540-K-05-003, April 2005).

2.1 Community Interviews

The contractor shall perform the following requirements under this subtask:

- Community Interviews Preparation. The contractor shall review relevant background documents as provided by the EPA WAM, and shall provide technical support as directed by the WAM in conducting community interviews. The WAM will conduct interviews with the appropriate governmental officials (federal, state, county, township, city), environmental groups, local broadcast and print media and any other relevant individuals or groups, either in person or via telephone.

- Community Interviews Questions. The contractor shall prepare draft interview questions for review by the EPA WAM. The contractor shall prepare final interview questions incorporating all EPA comments.

2.2 Community Relations Plan (CRP)

The contractor shall prepare a draft CRP that presents an overview of the community's concerns and covers the following elements: 1) site background including location, description and history; 2) community overview including a community profile, concerns and involvement; 3) community involvement objectives and planned activities, with a proposed schedule for performance of these activities; 4) a mailing list of contacts and interested parties; 5) names and addresses of the information repositories and public meeting facility locations; 6) a list of acronyms; and 7) a glossary. The contractor shall submit the final CRP incorporating all EPA review comments.

2.3 Public Meeting Support

The contractor shall perform the following activities in support of public meetings, availability sessions, and open houses under this work assignment:

- The contractor shall make reservations for a meeting space, per the technical direction of the EPA WAM.
- The contractor shall attend the public meetings and the availability session, and prepare meeting summaries. For budgeting purposes, the contractor shall assume that two (2) public meetings and one availability session (1) will be held.
- The contractor shall prepare draft visual aids in Power Point, as directed by the EPA WAM. For budgeting purposes, the contractor shall assume that 35 slides, and 75 handouts will be required for each public meeting. The contractor shall prepare the handouts in English and Spanish. The contractor shall prepare final visual aids incorporating all EPA comments.
- The contractor shall reserve a court reporter for the public meeting as directed by the EPA WAM. The contractor shall provide a full-page original and a "four on one" page copy, along with an electronic version of the transcripts, with additional copies placed in the information repositories as required by the WAM.
- The contractor shall prepare and maintain a sign-in sheet for each public meeting. The contractor shall make use of the names provided on the sign-in updating the site mailing list (see Subtask 2.8).

2.4 Fact Sheet Preparation

The contractor shall prepare draft information letters/updates/fact sheets in accordance with the approved CRP for the site. For budgeting purposes, the contractor shall assume 3 fact sheets (1 fact sheet for each meeting), 2 to 4

pages in length, with 3 illustrations per fact sheet. The contractor shall research, write, edit, design, layout, and photocopy the fact sheets. The fact sheets shall be written in English and Spanish. The contractor shall prepare the final information letters/updates/fact sheets incorporating all EPA review comments. The contractor shall attach mailing labels to the final fact sheets before delivering them to EPA, who will be responsible for mailing the fact sheets.

2.5 Proposed Plan Support – Not Applicable

2.6 Public Notices

The contractor shall prepare newspaper announcements/public notices in the most widely read local newspaper(s), in support of each of the 3 public meetings and availability sessions. The contractor shall budget for the preparation of 3 newspaper advertisements (Spanish and English) in the most widely read local newspapers, with each ad placed in two large newspapers and a small town local newspaper.

2.7 Information Repositories - Not Applicable

2.8 Site Mailing List

The contractor shall develop a mailing list used for community relations activities at this site. For budgeting purposes, the contractor shall assume that the mailing list will be updated twice, and that the mailing list will contain about 150 entries. At the request of the EPA WAM, the contractor shall provide a copy of the mailing list on disk and mailing labels for each mailing. EPA will do the actual mailing of any information to the community.

2.9 Responsiveness Summary Support

The contractor shall provide administrative and technical support for the site Responsiveness Summary. As directed by the EPA WAM, the contractor shall prepare a draft Responsiveness Summary compiling and summarizing comments received during the public comment period on the Proposed Plan. The contractor shall also prepare technical reviews and draft responses for selected technical comments, for EPA's review and use in preparing the formal responses. For budgeting purposes, the contractor shall assume receipt of 150 separate comments (including duplicates) and preparation of 150 technical responses.

Task 3 Field Investigation

Data acquisition entails collecting environmental samples and information required to support the RI/FS. The plans describing requirements for collection of the field data are discussed in Task 1. Data acquisition under this task begins with EPA's approval of the QAPP and ends with the demobilization of field personnel and equipment from the site. The contractor shall perform the following field activities for data acquisition in accordance with the EPA-approved QAPP prepared under Task 1.

3.1 Site Reconnaissance

The contractor shall conduct site surveys including property, boundary, utility rights-of-way, and topographic information. These surveys shall include the following activities as necessary for precise characterization of site features pertinent to the field investigations:

- Aerial photography and analysis
- Existing well development and establishment of sampling points.
- On-site well sampling
- Surface water sampling
- Soil sampling
- Sediment sampling, (if necessary - see Subtask 3.3, Item v)

- Photographic documentation. The contractor shall take representative photographs to document the RI field activities and significant events and/or observations made during the RI/FS. These activities shall include contractor mobilization, collection of samples, ecological studies, treatability studies (if required), and demobilization. The contractor shall photograph these activities so that the photographs will serve as a clear record of the procedures required to carry out each activity. The contractor shall also store and maintain these photographs in electronic form and submit them to EPA on disk. For each photograph, the contractor shall provide the time, date, location and a brief explanation of what is being photographed.

The contractor shall submit a monthly field activity report to the EPA WAM by electronic mail and hardcopy.

3.2 Mobilization and Demobilization

The contractor shall provide the necessary personnel, equipment, and materials for mobilization and demobilization to and from the site.

Mobilization activities include:

- Site preparation
- Installation of utilities
- Lease of temporary facilities
- Establishment of health and safety zones
- Initial health and safety debriefing for all project team members

Demobilization activities include:

- Demobilization of field laboratory (if one was used)
- Decontamination and removal of equipment and temporary facilities
- Site restoration

3.3 Hydrogeological Assessment

The contractor shall perform the following activities under this subtask:

i. Assessment of all existing monitoring wells and evaluation of their suitability, both conceptually and technically, for sampling required to characterize site contamination accurately and thoroughly for the RI.

ii. Installation of additional monitoring wells as necessary to supplement existing monitoring wells for the performance of the RI (see section 3.4, below).

iii. Groundwater elevation measurements.

iv. A surface water reconnaissance/evaluation to determine whether a surface water body could be potentially impacted by contaminated groundwater or site runoff.

v. A groundwater and site runoff/surface water interaction evaluation, should the surface water reconnaissance/evaluation under Item "iv." indicate that a surface water body could be potentially impacted by either contaminated groundwater or site runoff.

3.4 Soil Boring, Drilling, and Testing

The contractor shall install monitoring wells and perform soil borings as directed by EPA. The contractor shall record formation cuttings, type, and sorting and drilling rates during the boring and drilling activities. The contractor shall also prepare and maintain geophysical logs (gamma, resistivity, caliper) of each boring.

3.5 Environmental Sampling

The contractor shall perform the following activities under this subtask:

- Field screening
- Groundwater sampling
- Surface and subsurface soil sampling
- Soil boring/permeability sampling
- Surface water and sediment sampling (if necessary - see Subtask 3.3, Item v)
- Air monitoring sampling for health and safety
- Indoor Air for vapor intrusion, if necessary

3.6 Ecological Characterization

The contractor shall perform the following activities under this subtask:

- Habitat delineation/function and value assessment
- Benthic reconnaissance/community characterization, (if necessary - see Subtask 3.3, Item v)
- Biota sampling/population studies, (if necessary - see Subtask 3.3, Item v)
- Bioaccumulation studies, (if necessary - see Subtask 3.3, Item v)
- Sediment toxicity tests (if necessary - see Subtask 3.3, Item v)

Note: Implementation of these activities will depend on the results of the Screening-Level Ecological Risk Assessment (SLERA) that indicate a need to proceed to a Baseline Ecological Risk Assessment. (See Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments [ERAGS], USEPA, 1997 [EPA/540-R-97-006] - Steps 1 and 2, and other requirements under Subtask 7.2.) For budgeting purposes, the contractor shall assume that these ecological characterization activities will be required, and address these requirements as part of its draft work plan and budget.

3.7 Geotechnical Survey

The contractor may perform the following surface/subsurface geophysical activities under this subtask:

- Magnetometer
- Electromagnetic
- Ground-penetrating radar
- Resistivity

3.8 Investigation-Derived Waste (IDW) Characterization and Disposal

The contractor shall characterize and dispose of investigation-derived wastes in accordance with local, State, and Federal regulations as specified in the QAPP (reference the *Guide to Management of Investigation-Derived Wastes*, 9345.3-03FS [January 1992]).

Task 4 Sample Analysis

The contractor shall arrange for the analysis of environmental samples collected during Task 3. The contractor's work plan budget for this task shall include only the cost of the sample analysis. Costs for efforts associated with sample collection shall be included in Task 3, efforts associated with shipment and validation included in Task 5, and efforts associated with data evaluation included in Task 6. In accordance with the approved work plan and QAPP for this work assignment, the contractor shall analyze the samples as outlined in the following subtasks:

Note: *Implementation of these activities will depend on the results of the Screening-Level Ecological Risk Assessment (SLERA) which indicate a need to proceed to a Baseline Ecological Risk Assessment. (See* Ecological

Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments [ERAGS], *USEPA, 1997 [EPA/540-R-97-006] - Steps 1 and 2, and other requirements under Subtask 7.2.) For budgeting purposes, the contractor shall assume that these ecological characterization activities will be required, and address these requirements as part of its draft work plan and budget.*

4.1 Innovative Methods/Field Screening Sample Analysis

The contractor shall perform the following the following types of sample analyses under this subtask:

- Analyze groundwater
- Analyze surface water and sediment samples, (if necessary - see Subtask 3.3, Item v)
- Analyze surface and subsurface soil samples
- Analyze soil boring/permeability samples
- Analyze air samples (indoor air for vapor intrusion and ambient air monitoring during field investigation activities)

4.2 Analytical Services Provided Via CLP, DESA or EPA-ERT

The contractor shall identify the number and types of samples as called for below. Analysis of these samples will be performed by Region 2 DESA, CLP, or ERT.

- Analyze groundwater samples
- Analyze surface water samples
- Analyze soil and sediment samples
- Analyze soil boring/permeability samples
- Analyze indoor air samples for vapor intrusion, if necessary.

4.3 Non-Routine Analytical Services - Optional

Note: *This subtask is an optional requirement. The contractor shall not include a cost estimate for performance of this subtask as part of its work plan budget. In the event that EPA determines that performance of this subtask is necessary, a WA amendment will be issued to formally implement these requirements into this work assignment.*

The contractor shall perform the following types of sample analysis under this subtask:

- Analyze groundwater samples
- Analyze surface water samples
- Analyze soil and sediment samples
- Analyze soil boring/permeability samples
- Analyze indoor air samples
- Analyze soil characteristics and engineering properties to evaluate the feasibility of candidate remedial technologies for treatability studies and selection of remedial alternatives.

Task 5 Analytical Support and Data Validation

The contractor shall arrange for the validation of environmental samples analyzed under Task 4. Sample validation under this task begins with the completion of the field sampling program and reservation of sample slots in the CLP, and ends with the contractor's validation of the analytical data received from the laboratory. The contractor shall validate all analytical data, whether received from EPA laboratories, CLP laboratories, or subcontracted laboratories.

The contractor shall ensure that all subcontracted laboratory analyses are performed in accordance with generally-accepted EPA methods, and shall submit all analytical data from subcontracted laboratories to EPA in a CLP-deliverable format. The contractor shall perform the activities described in the following subtasks:

5.1 Prepare and Ship Samples

The contractor shall prepare and ship the analytical samples collected under Task 3 in accordance with the approved QAPP.

5.2 Sample Management

The contractor shall perform sample management, covering the following activities:

- Coordinate with the EPA Sample Management Office (SMO), the Region 2 Sample Control Coordinator (RSCC), the Division of Environmental Science and Assessment (DESA) and/or other applicable EPA sample management offices regarding analytical, data validation, and quality assurance issues.

- Implement EPA-approved laboratory quality assurance program to provide oversight of in-house and/or subcontract laboratories.

- Provide chain-of-custody, sample retention, and data storage functions in accordance with the approved contract-wide QAPP, QMP and contract requirements. The contractor shall ensure that accurate chain-of-custody procedures are implemented and carried out for sample tracking, protective sample packing is performed, and proper sample preservation techniques are used.

5.3 Data Validation

The contractor shall validate the data to ensure that the data and chain-of-custody are accurate and defensible. The contractor shall perform the following activities under this subtask:

- Review analysis results against validation criteria.
- Review the data and make a data usability determination.
- Provide a data validation report to the EPA WAM after all data have been validated.

Task 6 Data Evaluation

The contractor shall organize and evaluate existing data and data gathered during the previous tasks that will be used later in the RI/FS effort. Data evaluation begins with the receipt of analytical data from Task 5, and ends with the submittal of the Data Evaluation Summary Report. The contractor shall perform the following activities under this task:

6.1 Data Usability Evaluation

The contractor shall evaluate the usability of the data, including any uncertainties associated with the data.

6.2 Data Reduction, Tabulation, and Evaluation

The contractor shall evaluate, interpret, and tabulate data in an appropriate presentation format for final data tables. The following shall be used as general guidelines in the preparation of data for the RI report:

- Tables of analytical results should be organized in a logical manner such as by sample location number, sampling zone, or some other logical format. Groundwater analytical results shall be separated into groups based on the hydrogeologic framework such as shallow aquifer upgradient, deep aquifer upgradient, shallow aquifer downgradient and deep aquifer downgradient. Well identification numbers within each set could be ordered according to whatever alpha-numeric system is used for the well identification numbers. Surface/subsurface soil analyses shall be separated according to site location or specific contaminant source and background areas. The contractor shall coordinate the table organization with the EPA WAM.

- Analytical results shall not be organized by laboratory identification numbers because these numbers do not

correspond to those used on sample location maps. The sample location/well identification number shall always be used as the primary reference for the analytical results. The sample location number shall also be indicated if the laboratory sample identification number is used.

- Analytical tables should indicate the sample collection dates.
- The detection limit shall be indicated in instances where a parameter was not detected.
- Analytical results shall be reported in the text, tables and figures using a consistent convention such as ug/l for groundwater analyses and mg/kg for soil analyses.
- The lead agency's protocol for eliminating field sample analytical results based on laboratory/field blank contamination results shall be clearly explained.
- Discussion of approved sampling results shall not be qualified by suggesting that a particular chemical is a common lab contaminant or was detected in the lab blank. If the reported result has passed QA/QC it shall be considered valid. In cases where the chemical in question was known to have been used and/or disposed of on site, positively identified at high levels in other environmental media, and passes QA/QC protocols, the sampling results shall not be questioned as being due to laboratory contaminants.
- Field equipment rinsate blank analyses results shall be discussed in detail if decontamination solvents are believed to have contaminated field samples.

6.3 Modeling - *Optional*

Note: *This subtask is an optional requirement. The contractor shall not include a cost estimate for performance of this subtask as part of its work plan budget. In the event that EPA determines that performance of this subtask is necessary, a WA amendment will be issued to formally implement these requirements into this work assignment.*

The contractor shall evaluate the existing data collected under the field investigation and make an assessment of the need for modeling to complete an accurate characterization of the nature, extent, distribution and movement of site contamination. This evaluation will also cover the historical distribution and movement of site contamination (forensic modeling) to help identify potential source areas, utilizing the results of the chemical fingerprinting analysis. The contractor shall provide a technical memorandum to the EPA WAM summarizing the results of this evaluation and its recommendations concerning performance of modeling for this RI/FS. Based on its review of this technical memorandum, EPA will determine whether modeling will be conducted for this RI/FS, and will direct the contractor to perform a modeling effort if required.

6.4 Data Evaluation Summary Report

The contractor shall evaluate and present results in a Data Evaluation Summary Report and submit to the EPA WAM for review and approval. The report shall include an evaluation of the historical data, identify gaps that may be addressed as part of the RI, include a summary of data gathered as part of the field investigation, and identify data gaps for future investigations. If additional analytical data are needed or if significant data problems are identified during the evaluation, the contractor shall provide a separate memorandum describing these problems for review by the WAM.

Task 7 Assessment of Risk

The risk assessment will determine whether site contaminants pose a current of potential risk to human health and the environment in the absence of any remedial action, and will be used to determine whether remediation is necessary at the site, provide justification for performing remedial action, and determine what exposure pathways need to be remediated. The contractor shall perform the risk assessment, addressing the contaminant identification,

exposure assessment, toxicity assessment, and risk characterization, in accordance with the requirements of the following subtasks.

7.1 Baseline Risk Assessment (Human Health)

The contractor shall perform the Baseline Human Health Risk Assessment (HHRA) in accordance with the approach and parameters described in the approved Pathway Analysis Report (PAR). The requirements for the PAR are described in Subtask 1.13 above. The PAR must be reviewed by EPA prior to the submission of the draft risk assessment report. The contractor shall incorporate EPA review comments on the PAR into the draft HHRA.

Draft Baseline Human Health Risk Assessment Report: The contractor shall prepare a draft Baseline Human Health Risk Assessment report covering the following requirements:

- Hazard Identification. The contractor shall identify and describe the contaminants of potential concern (COPCs) based on their intrinsic toxicological properties.

- Dose-Response Assessment. Contaminants of concern should be selected based on their intrinsic toxicological properties.

- Characterization of Site and Potential Exposure Pathways. The contractor shall identify and characterize human populations in the exposure pathways.

- Exposure Assessment. The exposure assessment shall identify the magnitude of actual or potential human exposures, the frequency and duration of these exposures, and the routes by which receptors are exposed. The exposure assessment shall include an evaluation of the likelihood of such exposures occurring and shall provide the basis for the development of acceptable exposure levels. In preparing the exposure assessment, the contractor shall develop reasonable maximum estimates and central tendency (when appropriate) of exposure for both current and potential land use conditions at the site. The rationale for use of site-specific over default exposure factors should be clearly explained and justified.

- Toxicity Assessment. The contractor shall list all toxicity values (e.g., slope factors and reference doses) for the COPCs and the sources of the toxicity values, in accordance with EPA's current toxicity hierarchy ((see "Human Health Toxicity Values in Superfund Risk Assessments," OSWER Directive 9285.7-53, December 5, 2003). The contractor shall submit chemicals without assigned toxicity values in Tiers 1 and 2 to EPA for determination of the appropriate value.

- Risk Characterization. During risk characterization, chemical-specific toxicity information, combined with quantitative and qualitative information from the exposure assessment, shall be compared to measured levels of contaminant exposure and the levels predicted through environmental fate and transport modeling. These comparisons shall determine whether concentrations of contaminants at or near the site are affecting or could potentially affect human health. Based on these results, the contractor shall also address other aspects important to the risk characterization, such as a qualitative discussion of chemicals without toxicity data and how concentrations found on site relate to background concentrations.

- Identification of Limitations/Uncertainties. The contractor shall identify critical assumptions and uncertainties (e.g., background concentrations, modeling inputs, toxicity data, environmental data, et al.) in the report.

- Site Conceptual Model. The contractor shall develop a conceptual model of the site based on the contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

Final Baseline Human Health Risk Assessment Report: The contractor shall submit the final Baseline Human Health Risk Assessment Report incorporating all EPA review comments.

7.2 Baseline Risk Assessment - Ecological Risk Assessment

The contractor shall perform a Screening-Level Ecological Risk Assessment (SLERA) in accordance with current Superfund ecological risk assessment guidance (*Ecological Risk Assessment Guidance for Superfund, Process for Designing and Conducting Ecological Risk Assessments [ERAGS], EPA/540-R-97-006, June 1997*). The contractor shall compare the maximum contaminant concentrations in each medium of concern to appropriate conservative ecotoxicity screening values (e.g., Puerto Rico Water Quality Standards and Guidance Values, and USEPA's Ambient Water Quality Criteria [AWQC]), and shall use conservative exposure estimates. EPA will review and approve the SLERA and determine whether a full Baseline Ecological Assessment is required.

At EPAs direction, the contractor shall perform a Baseline Ecological Risk Assessment in accordance with EPA 540-R-97-006, ERAGS, dated June 5, 1997 (or more recent guidance). The contractor shall evaluate and assess the risk to the environment posed by site contaminants. As part of this effort, the contractor shall perform the following activities:

Draft Ecological Risk Assessment Report. The contractor shall prepare a draft Ecological Risk Assessment Report that addresses the following:

- Hazard Identification (sources). The contractor shall review available information on the hazardous substances present at the site and identify the major contaminants of concern.

- Dose-Response Assessment. Contaminants of concern will be selected based on their intrinsic toxicological properties.

- Characterization of Site and Potential Receptors. The contractor shall identify and characterize environmental exposure pathways.

- Select Chemicals, Indicator Species, and End Points. In preparing the assessment, the contractor shall select representative chemicals, indicator species (species that are especially sensitive to environmental contaminants), and end points on which to concentrate.

- Exposure Assessment. The exposure assessment will identify the magnitude of actual or environmental exposures, the frequency and duration of these exposures, and the routes by which receptors are exposed. The exposure assessment shall include an evaluation of the likelihood of such exposures occurring and shall provide the basis for the development of acceptable exposure levels. In developing the exposure assessment, the contractor shall develop reasonable maximum estimates of exposure for both current land use conditions and potential land use conditions at the site.

- Toxicity Assessment/Ecological Effects Assessment. The toxicity and ecological effects assessment will address the types of adverse environmental effects associated with chemical exposures, the relationships between magnitude of exposures and adverse effects, and the related uncertainties for contaminant toxicity (e.g., weight of evidence for a chemical's carcinogenicity).

- Risk Characterization. As part of the risk characterization, the contractor shall compare chemical-specific toxicity information, combined with quantitative and qualitative information from the exposure assessment, to measured levels of contaminant exposure levels and the levels predicted through environmental fate and transport modeling. These comparisons shall determine whether concentrations of contaminants at or near the site are affecting or could potentially affect the environment.

- Identification of Limitations/Uncertainties. The contractor shall identify critical assumptions (e.g., background concentrations and conditions) and uncertainties in the report.

- Site Conceptual Model. The contractor shall develop a conceptual model of the site based on the contaminant identification, exposure assessment, toxicity assessment, and risk characterization.

Final Ecological Risk Assessment Report: The contractor shall submit the final Ecological Risk Assessment report incorporating all EPA review comments.

Task 8 Treatability Study and Pilot Testing

Remedial technologies that may be suitable to the site should be identified as early as possible to determine whether there is a need to conduct treatability studies to better estimate costs and performance capabilities. The treatability study will determine the suitability of remedial technologies to site conditions and problems. The three levels of treatability studies are laboratory screening, bench-scale testing, and pilot-scale testing. The laboratory screening is used to establish the validity of a technology to treat waste and is normally conducted during the Feasibility Study. Bench-scale testing is used to identify the performance of the technology specific to a type of waste for an operable unit; bench-scale tests are often conducted during the FS. Pilot-scale testing is used to provide quantitative performance, cost, and design information for remediation, and is typically performed during the RI/FS (see *"Guide for Conducting Treatability Studies under CERCLA, final"* EPA/540/R-92/071a (October 1992).

8.1 Literature Search

The contractor shall research viable technologies that may be applicable to the contaminants of concern and the site conditions encountered. The contractor shall provide a technical memorandum to the EPA WAM summarizing the results of this literature search and assessing the need for additional treatability studies. As part of this document, the contractor shall submit a plan recommending performance of a treatability study at one of the above levels and identifying the types and specific goals of the study. The treatability study shall determine the suitability of remedial technologies to site conditions and problems. Based on its review of this technical memorandum, EPA will determine whether a bench test or pilot study will be conducted for this project, and will direct the contractor to prepare an addendum to the RI/FS work plan describing its detailed approach for performance of the treatability study, in accordance with the requirements described in Subtask 8.2 below.

Note: Subtasks 8.2 through 8.4 are optional requirements. In the event that EPA determines that performance of these subtasks are necessary, a WA amendment will be issued to formally implement these requirements into this work assignment.

8.2 Treatability Study Work Plan Addendum *(Optional)*

Upon implementation of this requirement, the contractor shall prepare a draft addendum to the RI/FS work plan describing its approach for performance of the treatability study, participate in negotiations to discuss the final technical approach and costs required to accomplish the treatability study requirements, and prepare a final work plan addendum and supplemental budget incorporating the agreements reached during the negotiations.

The treatability study work plan addendum shall describe the technology to be tested, test objectives, test equipment or systems, experimental procedures, treatability conditions to be tested, measurements of performance, analytical methods, data management and analysis, health and safety procedures, and residual waste management. The DQOs for the treatability study shall also be documented. If pilot-scale treatability studies are to be done, the treatability study work plan shall also describe pilot plant installation and startup, pilot plant operation and maintenance procedures, and operating conditions to be tested. If testing is to be performed off-site, permitting requirements shall be addressed. A schedule for performing the treatability study shall be included with specific dates for each task and subtask, including EPA review periods. Key milestones that should have completion dates specified included, but are not limited to, the procurement of contractors and the completion of sample collection, the performance period, sample analysis, and report preparation.

The treatability study work plan shall describe in detail the treatment process and how the proposed vendor or technology will meet the performance standards for the site. The treatability study work plan shall address how the contractor will meet all discharge or disposal requirements for any and all treated material, air, water, and expected effluents. In addition, the work plan addendum shall explain the proposed final treatment and disposal of all material generated by the proposed treatment system.

8.3 Conduct Treatability Studies *(Optional)*

The contractor shall conduct the treatability study in accordance with the approved treatability study addendum to the RI/FS work plan, QAPP, and HASP, to determine whether the remediation technology (or vendor of the technology) can achieve the required performance standards.

The following activities are required as part of the performance of the treatability study and pilot testing:

- Procure Test Facility and Equipment. The contractor shall procure the subcontractors, test facility and equipment necessary to perform the tests.
- Test and Operate Equipment. The contractor shall test the equipment to ensure proper operation, and operate or oversee operation of the equipment during the testing.
- Retrieve Sample for Testing. The contractor shall collect samples for testing as specified in the treatability study work plan.
- Perform Laboratory Analysis. The contractor shall establish a field laboratory to facilitate fast turnaround analysis of test samples, or, if necessary, shall procure outside laboratory services to analyze the test samples and evaluate test results.
- Characterize and dispose of residual wastes.

8.4 Treatability Study Evaluation Report *(Optional)*

The contractor shall prepare and submit the treatability study evaluation report that describes the performance of the technology. The study results shall clearly indicate the performance of the technology or vendor compared with the performance standards established for the site. The report shall also evaluate the treatment technology's effectiveness, implementability, cost, and final results compared with the predicted results. The report shall also evaluate full-scale application of the technology, including a sensitivity analysis identifying the key parameters affecting full-scale operation.

Task 9 Remedial Investigation Report

The contractor shall develop and deliver a Remedial Investigation (RI) report that accurately establishes the site characteristics such as the contaminated media, extent of and movement of contamination, the physical boundaries of the contamination, and the potential sources of contamination. Pursuant to this objective, the contractor shall obtain only the minimum essential amount of detailed data necessary to determine these parameters for the key contaminants. The contractor must select the key contaminants based on their persistence and mobility in the environment and their degree of hazard. The contractor shall evaluate the key contaminants identified for receptor exposure and prepare an estimate of the key contaminant(s) level reaching human or environmental receptors. The contractor shall use existing standards and guidelines such as drinking-water standards, water quality criteria, and other criteria accepted by EPA as appropriate for the situation to evaluate effects on human receptors that may be exposed to the key contaminants above appropriate standards or guidelines. The RI must be consistent with the baseline human health risk assessment.

The contractor shall prepare the RI report in accordance with the *"Guidance for Conducting Remedial Investigations/Feasibility Studies under CERCLA,"* OSWER Directive 9355.3-01, October 1988, and "Guidance for Data Usability in Risk Assessment, Parts A and B" (EPA 9285.7-09A, April 1992 and 9285.7-09B, May 1992). The EPA WAM shall specify the format for the report if Region 2-specific requirements or other special requirements are called for.

9.1 Draft Remedial Investigation Report

The contractor shall prepare a draft Remedial Investigation report in accordance with the above the guidance as well as the schedule in the final approved RI/FS work plan. An outline of the structure for the RI report and the subject areas and material to be covered is as follows:

1) Executive Summary

2) Introduction
   a) Purpose of the report
   b) Site background

   The contractor shall assemble and review available facts about the regional conditions and conditions specific to the site under investigation.
      i) Site description
      ii) Site history
      iii) Previous investigations
      iv) Previous emergency or interim actions
      v) Report organization

   The following guidelines shall be used in presenting the background discussion for this site:

- An index map should be used to show where the site is located within the Commonwealth. This may be provided as a separate map or as an inset on a regional site location map.
- A regional map should be provided showing the location of the site relative to nearby residential/industrial areas, public water supply wells, schools, parks, rivers, other surface waters, other hazardous waste sites, etc.
- A site map should be included showing the location of all present and past site structures/features. Labels or a key should be provided to explain the nature of each site feature. More than one map may be required to show these features if the site has undergone significant operational changes over time.
- A topographic contour map should be provided for the site. The scale used on these maps should provide sufficient detail so that sample locations can be accurately plotted in relation to site features (e.g., 1" = 20'). A very large site should be broken into a number of large-scale maps so that an adequate level of detail can be shown for the entire site. In this case a small-scale map should be used to show the entire site as well as indicate how the site has been divided into a number of large-scale maps. A consistent scale should be used for all of the large-scale maps for the site.
- The current and past status of the site should be clearly defined. Chemicals and hazardous materials used, stored disposed of, and/or produced at the site should be listed. Methods of waste disposal should be described.
- All previous environmental studies and investigations should be summarized and fully referenced. The summary should explain why each study was initiated, discuss the key findings and provide any relevant data summaries (chemical analyses, contaminant plume maps, etc.) in the text or appendices.
- A map should be provided which shows the locations of all previous environmental sampling and monitoring well locations. This information may be provided on maps showing proposed sampling locations.
- The Federal, Commonwealth and local regulatory history of the site should be discussed. Key memos, correspondence, court orders and other relevant documents relating to significant regulatory actions should be clearly referenced. A table may be used to summarize this information in addition to the text.
- Any previous environmental sampling results should be summarized. Tables and/or text should clearly indicate the types of media that were analyzed, sampling dates, analytical parameters, and the method detection limits for "non-detect" values. The parties responsible for each round of sampling and analyses should be clearly identified. Any significant sampling/lab QA/QC problems should also be noted.
- The findings of EPA's aerial photograph analysis provided in the Environmental Photographic Interpretation Center (EPIC) should be summarized or included as an appendix. (The EPA WAM may request EPA's National Exposure Research Laboratory, Environmental Services Division, Las Vegas, NV, to conduct an EPIC survey if one has not already been performed.)
- Any ecological concerns such as sensitive habitats and threatened or endangered species should be discussed.

3) Study Area Investigation
   a) Covers field activities associated with site characterization, including as appropriate physical and chemical monitoring of the following:
      i) Surface features (e.g., topographic mapping, natural and manmade features)
      ii) Field methodologies
      iii) Contaminant source investigations
      iv) Description of formation cuttings, type, sorting and drilling rates
      v) Soil borings
      vi) Meteorological investigations
      vii) Surface water and sediment investigations (if necessary - see Subtask 3.3, Item v)
      viii) Geological investigations
      ix) Soil and vadose zone investigations
      x) Groundwater investigations
      xi) Human populations surveys
      xii) Ecological investigations
      xiii) Vapor intrusion sampling (indoor air and subslab soil gas)
   b) Technical memoranda documenting field activities should be summarized in this chapter and included as an appendix to the RI report.

The following guidelines shall be followed in presenting the field investigation discussion:

Presenting Well and Subsurface Boring Log Information

- In developing final well logs from rough field logs, there should be no attempt to simplify the logs by eliminating data or observations obtained in the field. If necessary, additional pages may be included with the well log to explain any drilling problems, unusual observations, detailed stratigraphic descriptions or any other information that helps convey how the boring was installed and the nature of the subsurface conditions that were encountered.
- Boundaries between hydrogeologic units defined in a report should be annotated on well logs. This will allow the reader to quickly verify the hydrogeologic framework presented in the report.
- Mean sea-level elevations should be provided for the ground level and top of casing. Survey grid coordinates should be provided in addition to a short narrative description of the well location.
- The well/boring installation method and material should be completely summarized on the well log and/or well construction diagram. Precise descriptions should be provided for all cements, grouts, filter packs, seals, etc., to include specific compositions, trade names, depth of placement as well as any other pertinent details. The volume of these materials used in the construction of a well should also be reported.
- Well development/purging procedures should be documented for each well. This may be summarized on the well log or on an accompanying page. Important information to be included are the type of pump used in development, pumping rate, volume of water removed from the well, duration of well development and any water quality parameters (i.e., TDS, conductivity, pH) measured during the well development.
- For wells installed using mud-rotary techniques, it is particularly important to provide an estimate of the amount of mud lost into the formation. The depth at which significant volumes of mud are lost to the formation should also be recorded.

Presenting Geophysical Investigation Results

- The results of any downhole geophysical testing should be presented graphically to illustrate correlations between methods. Any reports or summaries provided by the geophysical subcontractor, including each log should be provided in an appendix.
- Maps should be provided that clearly show the locations of the geophysical stations/traverse lines and their relationship to potential contaminant source areas
- All details relating to types of geophysical instruments used, their use in the field (i.e. instrument spacing, QA/QC measurements, interference, etc.) and any other information that may affect the geophysical data such as solar/magnetic storms should be reported.
- All raw, uninterpreted data used to support document conclusions should be provided in the appendices. A complete explanation should be provided for how the raw data were manipulated and/or corrected in developing the geophysical conclusions.

- A surveyor's report should be included in the appendices if the geophysical stations/traverse lines were surveyed.
- The effective depth of exploration and limitations for each geophysical technique should be clearly defined. A calculation should be provided, if appropriate, to show how the depth of exploration was determined.
- The possible cause of all significant geophysical anomalies and their relationship to known or suspected contaminant source areas should be discussed.
- The contractor shall correlate geophysical data with other data available for the site. For example, if an electromagnetic survey is conducted in order to help define the extent of contaminated groundwater, conductivity measurements taken from monitoring wells located in the area of geophysical exploration may be used to corroborate and explain the results of the geophysical study.
- Geophysical anomalies due to sharp topographic changes that would affect an electromagnetic survey, or interference from trucks, power lines and fences, should be identified and explained.

Identifying Conditions Warranting Immediate Removal Action

- A discussion should be provided of any conditions that may warrant an immediate removal action to protect human health or the environment. Examples of this type of situation are leaking drums, leaking underground or above-ground storage tanks, a liquid-filled lagoon with a weakened berm, potentially explosive conditions and evidence of contaminated drinking water wells. As much detail as possible should be provided in the report so that the feasibility of conducting an immediate removal action can be evaluated.

4) Physical characteristics of the study area
   a) Covers the results of field activities to determine physical characteristics, including the following, as appropriate:
      i) Surface features
      ii) Meteorology
      iii) Surface water hydrology
      iv) Geology
      v) Soils
      vi) Hydrogeology
      vii) Demography and land use
      viii) Ecology
      ix)

The following guidelines shall be followed in presenting the discussion of site characteristics:

Regional Hydrogeologic Frameworks

- The development of a regional hydrogeology section should begin with a review of available U.S. Geological Survey, U.S. Department of Agriculture and/or Commonwealth agency bulletins or publications that provide information on the area of interest. If maps of regional geology, surface soil, aquifer thickness and groundwater elevation are available through these agencies, the relevant portions of these maps should be reproduced in the report and properly referenced. The legend/explanation for these maps should also be reproduced accurately so that all map symbols and notations can be easily understood.
- The discussion should focus on regional hydrogeologic information relevant to the site.
- Regional discussions should focus on characterizing those factors that control or affect groundwater flow patterns and/or groundwater quality. Detailed discussions of the timing and mechanisms of tectonic events or specific modes of deposition should be avoided, because these issues are often conjectural and belong more to the realm of academic research. The discussion should focus on how the physical characteristics of the regional hydrogeologic framework relate to site-specific contamination problems.
- Regional patterns of groundwater use by public and private wells and their potential impact on contaminant migration patterns should be discussed.
- All statements/information regarding regional hydrogeology should be fully referenced. It may be appropriate to provide excerpts from key reports as an appendix.

Site Hydrogeologic Frameworks

- It is essential that the development of a site hydrogeologic framework be based primarily on site-specific information. The hydrogeologic framework should be defined in descriptive terms based on subsurface sediment/lithologic characteristics, groundwater quality information and potentiometric data. Regional stratigraphic frameworks, although important in developing an understanding of the site geology, should not be used to define the hydrogeologic framework of the site. Formal stratigraphic nomenclature is often based on factors other than lithology, grain size or permeability. In some cases the recognized boundary, depth or thickness of a regional stratigraphic unit has no bearing whatsoever on hydrogeologic units or groundwater contaminant migration.
- Any key point of a conceptual hydrogeologic framework must be supported by the data collected as part of the report and/or previous reliable site-specific investigations. The use of prior investigations conducted by Potentially Responsible Parties (PRPs) without Commonwealth or federal oversight may not be appropriate.
- Well logs, soil boring logs and test pit logs, including all logs from previous investigations, should be included in the report appendices.
- A structure contour map of top of bedrock should be considered if bedrock structure controls groundwater flow patterns of the subsurface zone of interest.
- Glacial till should never be assumed to be impermeable. Fractures, common in glacial tills, can provide efficient pathways for contaminant migration.
- The terms "aquitard" and "aquiclude" should not be utilized in reports. These terms are not very useful in that their meanings are not well-defined. The U.S. Geological Survey recommends that the term "confining unit" be used instead of the terms "aquitard", "aquiclude", and "aquifuge" (USGS Open File Report 86-534, Aquifer Nomenclature Guidelines). The definition of an "aquitard" is a unit which is relatively less permeable. Therefore, a medium-grain sand unit below a unit of coarse sand and gravel could be accurately referred to as an aquitard. Although this may be technically correct, it is not very useful in describing the potential for contaminant migration because a medium-grained sand would not present a barrier to groundwater flow. Many non-technical reviewers interpret the word "aquitard" to represent an impermeable layer that will protect deeper aquifer zones from becoming contaminated. The terms "semi-confining unit" and "confining unit" are more appropriate terms to use to describe less permeable units in environmental hydrogeologic investigations.
- The term "confining unit" should be used only when it has been clearly established that the confining unit and the hydrogeologic units below it are unaffected by site-related contaminants, and/or potentiometric head data indicate that the unit serves as a hydraulic barrier to vertical groundwater flow. Clays and glacial tills are commonly referred to as confining units. However, fractures in clays and glacial tills can serve as effective pathways for contaminant migration. Shelby tube analyses and slug test methods do not measure fracture porosity in till and clays. Therefore, a clay or till unit should not be assumed to form an impenetrable barrier to downward migration of groundwater contamination based on laboratory or slug test data alone.
- Statements concerning groundwater discharge to nearby streams or surface waters should be based on the surface water/groundwater evaluation conducted under Subtask 3.3. Commonwealth, Federal and local agencies should be consulted to determine if stream gauge and/or water quality information is available for surface waters under investigation.
- Lineament/fracture trace analyses based on aerial/satellite imagery must be fully documented if they are to serve as reliable indicators of potential trends of fracture porosity in bedrock aquifers. The contractor shall provide clear and detailed copies of all photographs and/or other imagery to the EPA WAM. Linear features (lineaments) observed on aerial photographs cannot be assumed to be representative of fractures in bedrock. Many factors must be considered in developing a meaningful fracture trace analysis for a site. Scale, altitude, time of year, cultural influences, lighting angle and direction are all factors which can affect the type and/or the orientation of lineaments that can be detected using aerial photographs and/or satellite imagery. Field measurements of bedrock fractures at the outcrop's scale should be compared to the results of lineament analyses as well as major trends recognized in regional geologic investigations.
- The contractor shall provide a brief summary of the hydrogeologic framework for the site to the EPA WAM for review before the text of the first draft document is developed. It is essential to resolve issues such as the number of aquifer units, the presence or absence of confining units and the direction of groundwater flow at the site before the maps, tables, and figures are developed, to provide for agreement on these issues prior to the submittal of this summary.

- Accurate geologic cross-sections should be developed as part of the hydrogeologic investigation.

Potentiometric Contour Maps

- All groundwater elevations/potentiometric values should be expressed in terms of mean sea-level elevations.
- Groundwater contour maps should be based on synoptic water-level measurements and should reflect seasonal fluctuations (i.e., March measurements would be seasonal highs, late August seasonal lows, et al.).
- A potentiometric map should be developed for each aquifer zone for which there are groundwater elevation measurements from three or more wells.
- The base map used to develop potentiometric maps should show topographic contours, roads, surface waters, drainage features, site boundary and potential/known groundwater contaminant source areas, residential areas and any other significant cultural features.
- Potentiometric maps should represent only one round of groundwater level measurements. Potentiometric values should not be averaged over a number of rounds of groundwater elevation measurements.
- The date and time when the groundwater measurements were obtained should be stated in the map's title block.
- The elevations of surface waters in the immediate vicinity of the map should be indicated on the map. Surface water elevation measurement points should also be indicated on the map.
- A table should be used to provide the exact time that each water level measurement was made, depth to water from the measuring point, mean sea-level elevation of groundwater, surveyed elevation of the measuring point, and surveyed elevation of ground surface for each well.
- The wells used to develop a particular map should be indicated with a larger or bolder symbol so that they clearly stand out from other wells screened in different aquifer units. The mean sea-level elevation of groundwater for each well should be indicated in bold type next to the well.
- Groundwater elevation data from wells for which no well log description and/or construction log is available should not be used on potentiometric map.
- In areas where water table elevations are significantly influenced by tidal forces, a round of groundwater measurements should be obtained over the shortest possible period of time. Continuous groundwater level recorders provide the best record of tidal influences on groundwater levels, and allow investigators to develop maps of ground water levels at any particular instant of time over the measurement period. If continuous water level records are available, they should be provided in the text or in the appendices.

5) Nature and Extent of Contamination *(Note: The values used to determine nature and extent shall be approved by EPA prior to submittal of the draft Remedial Investigation report.)*

a) Presents the results of site characterization, both natural and chemical components and contaminants, as appropriate, in the following media:

i) Sources (lagoons, sludges, tanks)

A full description, utilizing all pre-existing information, should be provided for each potential contaminant source area within a site investigation area. A discussion should include the following points: dimensions, depth below grade, depth to water table, waste volume, type of wastes/products, construction/demolition/ closure dates, regulatory history, past/existing permits, historical changes in use or configuration, and available environmental sampling results.

A full description should be provided for all former structures and/or potential sources of contamination which may not be visible today as a result of construction and/or demolition activities.

ii) Soils and vadose zone

iii) Groundwater

iv) Surface water and sediments

v) Air

vi) Subsurface gases

b) *Contaminant Distribution and Trends.* The following guidelines shall be followed in presenting the discussion of contaminant profiles:

i) Site-specific background levels for inorganics and other parameters may need to be determined for soil, groundwater, surface water and sediment. Only information that relates directly to the site locale should be used to develop background levels. It is inappropriate to use studies which discuss average

values of these parameters found on Earth or in the North American hemisphere. High levels of certain inorganics (e.g., chromium) may be common in countries or states where certain minerals are abundant. However, these average soil levels cannot be compared to soil levels in an area where these minerals are not naturally occurring or where they occur only at very low levels. Location-specific background information can often be found by consulting USGS, USDA, or the Commonwealth geologic survey. These data should be summarized in a table in the report.

ii) Physical properties of site contaminants such as density, solubility, and mobility (Kow) should be discussed in relation to patterns of contaminant transport. A table should be used to summarize this information.

iii) Cosolvent effects should be considered in evaluating the potential mobility of contaminants in the environment. Many contaminants such as certain pesticides are relatively immobile. However, if they are mixed with other chemicals prior to or during their disposal, their mobility can be significantly increased. A review of historical records and memos may provide valuable information regarding on-site chemical formulation processes or waste disposal practices that may have resulted in increased mobilities for certain contaminants. In these cases, it may not be appropriate to use a laboratory-determined mobility factor (Kow) for a particular individual contaminant. Other factors that may affect contaminant migration such as colloidal transport, groundwater pH and redox potentials should also be considered.

iv) The potential for a floating (less dense than water) or deep (denser than water) layer of non-aqueous phase liquid (NAPL) contaminants should be considered if it is known or suspected that large quantities of liquid, pure phase contaminants have been disposed of at a site. In these cases, it is important to establish whether monitoring well screens are properly located to intercept these two types of non-aqueous phase groundwater contamination.

v) The levels of particular groundwater contaminants should be compared with their solubilities. If contaminant levels exceed ten percent of their solubility limit, this may indicate that a pure phase of the product may be present in the subsurface. If groundwater contaminant levels exceed the solubility limit, then it is clear that a pure phase of the product exists, either as a layer of pure product or in a colloidal form.

vi) No assumptions should be made regarding the valence state of inorganic contaminants if only "total" analyses have been performed. For example, no conclusions should be made regarding whether chromium detected in a ground water sample is Cr+3, Cr+4, Cr+5 and/or Cr+6 if only <u>total</u> chromium analyses have been conducted.

vii) When discussing groundwater/surface water analytical results, the text and tables should state whether the samples were filtered or unfiltered. Risk assessments for Superfund documents are normally based on <u>unfiltered</u> analyses. The contractor shall use filtered results only after consulting with the EPA WAM.

viii) The discussion of the nature and extent of site-related contaminants should focus on those contaminants that pose the most significant risk to human health and the environment and exceed Commonwealth or federal ARARs. Contaminants that occur at the highest levels do not necessarily pose the greatest health risk (e.g., iron and calcium). Therefore, discussions of site-related contamination should not focus solely on those contaminants occurring at the highest levels. The relative solubilities of the contaminants also control the levels at which they can occur in groundwater.

ix) Care should be taken when comparing past sampling results to those of recent sampling to ensure that the same sample collection methods, analytical methods and protocols were used as in the previous rounds of sampling. If different methods were used, the various sampling rounds cannot be compared quantitatively because differences in sample collection methods, equipment, detection limits and analytical methods can significantly affect analytical results. Therefore, only qualitative conclusions should be drawn regarding relative changes in contamination levels over time if the database consists of several different sampling events that have used different sample collection/analytical protocols and methodologies.

6) Contaminant Fate and Transport

a) Potential routes of migration (e.g.; air, groundwater, soils)

b) Contaminant persistence: Describe estimated persistence in the study area environment and physical, chemical, and/or biological factors of importance for the media of interest, as applicable;

c) Contaminant Migration:
   i) Discuss factors affecting contaminant migration for the media of interest (e.g., sorption onto soils, solubility in water, movement of groundwater, etc.)
   ii) Discuss modeling methods and results if applicable

The following guidelines shall be followed in presenting the fate and transport discussion:

Groundwater/Soil Contaminant Isoconcentration Plume Maps

- Isoconcentration maps of site-related contaminants should be developed to summarize RI groundwater sampling results. These maps will enable investigators and reviewers to quickly evaluate the extent and levels of site-related groundwater contamination and to make decisions regarding the need for additional monitoring wells, the scope of groundwater remediation strategies and the potential threat to off-site groundwater sources.
- The number and types of isoconcentration maps that will be required for a site will depend on the nature of the site contamination. A total volatile organics and total semi-volatile organics isoconcentration map should be prepared if these types of contaminants exceed Commonwealth or federal action levels. Isoconcentration maps for specific site-related inorganic groundwater contaminants that exceed ARARs should also be considered. Isoconcentration maps should be considered for any contaminant or group of site-related contaminants that occur at high levels and/or pose a relatively high risk to human health or the environment.
- Isoconcentration maps should be developed for each aquifer zone so that the nature and lateral extent of groundwater contamination in different aquifer zones can be easily compared. Data for these maps should be from the narrowest time frame possible so that a "snapshot" picture of the plume can be established.
- If possible, contaminant plumes should be shown in cross-section, especially along the longitudinal axis of plume (along groundwater flow gradient) and transverse to long axis, preferably at widest lateral extent.
- All residential wells, surface water discharge points or public supply wells should be indicated on a contaminant isoconcentration map. Annotations should be provided along the margin of the map indicating the distance and direction to important public water supply well fields or industrial wells that do not fall within the map boundary.
- All available well sampling information should be utilized in developing an isoconcentration map. Groundwater sampling results generated by other sources, such as local public health department residential well sampling, should be utilized if available. Different symbols should be used to show these well locations and the map explanation should identify the source of this information.
- A summary of sampling results from other sources should be provided in the text. This summary should discuss sampling parameters, sampling/analytical methodology and detection limits.
- All indicators of the probable extent of the groundwater contaminant plume should be considered when developing contaminant isoconcentration maps. These factors to be considered include geophysical survey results, the contaminant source area locations, historical information, subsurface boring descriptions of contamination below the water table, subsurface soil sampling results and the direction of groundwater flow. (For example, if an unlined lagoon is the source of a groundwater contaminant plume, the outer boundary of the plume should include the entire lagoon area. It would be inappropriate to draw the plume boundary as passing through the center of the lagoon.) Computer contouring often results in an inadequate product because the programs do not incorporate all the relevant factors that should be considered when developing a contour map. In such cases the data should be contoured by hand.
- The degree of confidence of various sections of an isoconcentration map may be indicated with solid lines (high confidence), dashed lines (low confidence) and dotted lines or question marks (very low confidence).

Interpretations Regarding the Nature and Extent of Site-Related Contamination

- Probably the most important task involved in understanding site-related contamination is to integrate all available information to develop a full understanding of the site. Although it is often appropriate to discuss soil, groundwater, and contaminant source material analytical sampling results in separate sections, at some point it is necessary to compare and contrast the levels and types of contaminants found in the source areas versus those found in related soils and downgradient groundwater.
- Valid sampling results from previous investigations should be considered when developing an interpretation of site-related contamination. This is particularly important if these previous investigations sampled locations or analyzed for parameters not included in the current investigation. It would be

inappropriate to ignore contamination "hot spots" identified by previous studies or suspected "hot spots" based on historical information simply because the current investigation did not address certain locations.

- The vertical and lateral extent of site-related contamination must be accurately reported. The text should clearly describe the limits of our understanding of the extent of contamination if sampling efforts have not defined the vertical and lateral extent of contamination. (For example, statements such as "groundwater contamination extends to a depth of 45 feet below surface" would be inappropriate if no groundwater samples are available below 45 feet). Any data gaps in the understanding of the extent of contamination should be clearly defined and a recommendation should be made concerning what additional sampling would be required to determine the extent of contamination.

7) Baseline Risk Assessment
   a) Human health risk assessment
      i) Hazard identification
      ii) Exposure assessment
      iii) Toxicity assessment
      iv) Risk characterization/uncertainty discussion
   b) Environmental Evaluation

8) Summary and Conclusions
   a) Summary
      i) Nature and extent of contamination
      ii) Fate and transport
      iii) Risk assessment
   b) Conclusions
      i) Data limitations and recommendations for future work
      ii) Recommended remedial action objectives

9) References

10) Tables and Figures

11) Appendices (including log books, soil boring logs, test pit/trenching logs, monitoring well construction diagrams, private and public well records, analytical data and QA/QC evaluation results)

The contractor shall prepare the summary and conclusions of the RI report in accordance with the following guidelines:

Figure Guidelines

- The original source of each figure should be referenced. If a pre-existing figure has been modified, the figure should indicate the original source of the figure that has been modified.
- The area of interest should be enlarged to fill as much of the available space on the page/plate as possible.
- All units, symbols, patterns and scales used on figures must be fully explained in a key provided on the figure.
- Whenever possible, key figures/tables should be inserted in the text following the page on which they are first referenced.
- All text and symbols used on maps, tables and figures should be legible. To avoid illegibility during reproduction, nothing in a original should be smaller than 17 characters per inch (CPI).
- Page numbers should be given to figures so that they can be easily located or replaced in the text.
- Well identification numbers should indicate the depth interval or hydrogeologic zone in which they are screened. For example, D-1 might indicate deep well number one and S-7 might indicate shallow well number seven. The designation of depth zones and well identification numbers should be consistent throughout the various phases of an investigation.
- Residential wells should be referred to by an alphanumeric system such as RES-1. A table should be included indicating the street address and any construction/operational information on these wells. Family names should not be used to refer to residential wells because property owners/renters can change

Map Format

- All maps must include an accurate north arrow, scale, a title explaining the purpose of the map, and an explanation of all symbols/notations. A reference should be provided to the source of the map if it is based on a pre-existing map.
- The scale should include both a written scale and a graphical scale. The inclusion of a graphical scale is essential because its accuracy will be retained even if the map is deliberately or inadvertently enlarged or reduced through reproduction processes. A written scale will no longer be accurate once a map has been enlarged or reduced.
- At least one base map with a map scale of "one inch equals fifty or one hundred feet" should be utilized to accurately show the location of environmental sampling locations relative to known source areas, topographic contours, site boundary and other important features. Several maps may be utilized if the site consists of several source areas spread over a large area.
- The surveyor's reference point/benchmark should be identified on the map and discussed in the text.
- Text and numbers should be oriented on the map so that the north arrow is pointing in an upward direction as one reads the map. The orientation of text and numbers relative to north should be consistent from map to map throughout the report.
- All units, symbols and patterns used on the map should be fully described in an explanation included on the map. For groundwater elevation or groundwater contaminant level values, the map explanation should state exactly how the map values were derived. The date that the data were collected should be indicated if the data are representative of a certain point in time.
- The map title and figure/plate number should be shown in large bold type so that the map can be quickly identified.
- Maps must be presented in digitized Arc Info format or GIS format as requested by the EPA WAM.

Presenting Analytical Results

- Tables of analytical results should be organized in a logical manner, such as by sample location number, sampling zone, or some other logical format. For example, groundwater sampling results may be separated into three sets of data, upgradient, on-site, and downgradient. Groundwater analytical results may be separated into groups based on the hydrogeologic framework, such as shallow aquifer upgradient, deep aquifer upgradient, shallow aquifer downgradient and deep aquifer downgradient. Well identification numbers within each set may be ordered according to the alphanumeric system used for the well identification numbers.
- Analytical results should not be ordered by laboratory identification numbers because these numbers do not correspond to those used on sample location maps. The sample location/well identification number should always be used as the primary reference for the analytical results. The sample location number should also be indicated if the laboratory sample identification number is used.
- Analytical tables should indicate the sample collection dates.
- The detection limit should be indicated in instances where a parameter was not detected.
- Analytical results should be reported in the text, with tables and figures using a consistent convention such as ug/l for groundwater analyses and mg/kg for soil analyses.

Discussion of Laboratory/Field Blank Contamination

- The contractor shall refer to the current CLP statements of work for analysis of organic and inorganic substances for guidance on how laboratory/field blank contamination results should be used to interpret field sample analytical results.
- The lead agency's protocol for eliminating field sample analytical results based on laboratory/field blank contamination results should be clearly explained.
- The discussion of approved sampling results should not be qualified by suggesting that a particular chemical is a common lab contaminant or was detected in the lab blank. If the reported result has passed QA/QC it should be considered valid. In cases where the chemical in question was known to have been used and/or disposed of on site, positively identified at high levels in other environmental media, and passes QA/QC protocols, the sampling results should not be questioned as being due to laboratory contaminants.
- Field equipment rinsate blank analyses results should be discussed in detail if decontamination solvents are believed to have contaminated field samples.

9.2 Final Remedial Investigation Report

The contractor shall submit the final groundwater Remedial Investigation report incorporating all EPA review comments.

Task 10 Remedial Alternatives Screening

This task covers the development of appropriate remedial alternatives that will undergo full evaluation. The alternatives are to encompass a range, including innovative treatment technologies, consistent with the regulations outlined in the National Contingency Plan (NCP), 40 CFR Part 300, the "Guidance for Conducting Remedial Investigations and Feasibility Studies under CERCLA" (OSWER Directive 9355.3-01, October 1998), and other applicable OSWER directives, policies and guidance, as referenced in www.epa.gov including 9355.4-03, October 18, 1989, and 9283.1-06, May 27, 1992, "Considerations in Ground Water Remediation at Superfund Sites") or more recent directives, policies, procedures, and guidance, as referenced in www.epa.gov//superfund/policy/remedy/sfremedy/remedies.htm.

The contractor shall investigate only those hazardous waste management alternatives that will remediate or control contaminated media (soil, surface water, groundwater, sediments) remaining at the site, as determined necessary in the RI to provide adequate protection of human health and the environment. The potential alternatives shall encompass a range of alternatives in which treatment is used to reduce the toxicity, mobility, or volume of wastes but vary in the degree to which long-term management of residuals or untreated waste is required, and shall include one or more alternatives involving containment with little or no treatment as well as a no-action alternative.

10.1 Technical Memorandum

The contractor shall prepare a draft technical memorandum presenting the potential alternatives and including the following information:

- *Establish Remedial Action Objectives.* Based on existing information, the contractor shall identify site-specific remedial action objectives that should be developed to protect human health and the environment. The objectives shall specify the contaminants and media of concern, the exposure routes and receptors, and an acceptable contaminant level or range of levels for each exposure route (i.e., preliminary remediation goals).

- *Establish General Response Actions.* The contractor shall develop general response actions for each medium of interest by defining contaminant treatment, excavation, pumping, or other actions, singly or in combination, to satisfy remedial action objectives. The response actions shall take into account requirements for protectiveness as identified in the remedial action objectives as well as the chemical and physical characteristics of the site.

- *Identify & Screen Applicable Remedial Technologies.* The contractor shall identify and screen technologies based on the developed general response actions. The contractor shall identify and screen hazardous waste treatment technologies in order to ensure that only those technologies applicable to the contaminants present, their physical matrix, and other site characteristics will be considered. This screening will be based primarily on a technology's ability to effectively address the contaminants at the site, but will also take into account a technology's implementability and cost. The contractor shall select representative process options, as appropriate, to carry forward into alternative development. The contractor shall identify the need for treatability testing for those technologies that are probable candidates for consideration during the detailed analysis.

- *Develop Remedial Alternatives* in accordance with NCP.

- *Screen Remedial Alternatives for Effectiveness, Implementability, and Cost.* The contractor shall screen alternatives to identify the potential technologies or process options that will be combined into media-specific or site-wide alternatives. The contractor shall define the developed alternatives with respect to the

size and configuration of the representative process options; time for remediation; rates of flow or treatment; spatial requirements; distances for disposal; and required permits, imposed limitations, and other factors necessary to evaluate the alternatives. If many distinct, viable options are available and developed, the contractor shall screen the alternatives that will undergo the detailed analysis in order to provide the most promising process options. The contractor shall screen these alternatives on a general basis with respect to their effectiveness, implementability, and cost.

10.2 Final Technical Memorandum

The contractor shall incorporate EPA's review comments on the draft technical memorandum into the draft Feasibility Study report prepared under Subtask 12.1. The contractor shall not submit a separate final technical memorandum for the sections of the FS report covered in Task 10.

Task 11 Remedial Alternatives Evaluation

This task covers efforts associated with the assessment of individual alternatives against each of the nine current evaluation criteria and a comparative analysis of all options against the evaluation criteria. The analysis shall be consistent with the National Contingency Plan (NCP), 40 CFR Part 300 and shall consider the "Guidance for Conducting Remedial Investigation and Feasibility Studies under CERCLA" (OSWER Directive 9355.3-01, October 1988) and other pertinent OSWER guidance. EPA will make the determination regarding final selection of the remedial alternative.

The nine criteria the contractor shall employ in the evaluation of remedial alternatives are:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction in toxicity, mobility or volume through treatment
- Short-term effectiveness
- Implementability - technical and administrative
- Cost
- State acceptance
- Community acceptance

11.1 Technical Memorandum

The contractor shall prepare a technical memorandum that addresses the following: (1) a technical description of each alternative that outlines the waste management strategy involved and identifies the key ARARs associated with each alternative; and (2) a discussion that profiles the performance of that alternative with respect to each of the evaluation criteria. The contractor shall provide a table summarizing the results of this analysis. After presentation of the complete analysis of each individual alternative, the contractor shall compare and contrast the alternatives to one another with respect to each of the evaluation criteria.

11.2 Final Technical Memorandum

The contractor shall incorporate EPA's review comments on the draft technical memorandum into the draft Feasibility Study report prepared under Subtask 12.1. The contractor shall not submit a separate final technical memorandum for the sections of the FS report covered in Task 11.

Task 12 Feasibility Study Report

The Contractor shall prepare a Feasibility (FS) report consisting of a detailed analysis of alternatives and a cost-effectiveness analysis in accordance with the National Contingency Plan (NCP), 40 CFR Part 300, and current EPA feasibility study guidance.

12.1 Draft Feasibility Study Report

The contractor shall submit a draft Feasibility Study report in accordance with the performance schedule in the approved RI/FS work plan. To expedite the completion of the report, the contractor shall provide draft chapters of the report to the EPA WAM as they are completed. The FS report shall contain the following:

- Feasibility Study objectives
- Remedial objectives
- General response actions
- Identification and screening of remedial technologies
- Description of remedial alternatives
- Detailed analysis of remedial alternatives
- Summary and Conclusions

The contractor's technical feasibility considerations shall address in detail any problems that may prevent a remedial alternative from mitigating site problems. Accordingly, the contractor must present the technical feasibility of each remedial alternative considering the site characteristics from the RI. The contractor shall also address the reliability, safety, and operation and maintenance of each alternative, the ease with which the alternative can be implemented, and the time needed for implementation.

12.2 Final Feasibility Study Report

After EPA's review of the draft Feasibility Study report (which will incorporate the EPA review comments on the technical memoranda prepared under Subtasks 10.1 and 11.1 above), the contractor shall submit the final FS report incorporating all EPA review comments.

Task 13 Post RI/FS Support

The contractor shall provide technical support required for preparation of the Record of Decision for the site, excluding the community relations activities addressed under Task 2 of this SOW. The contractor's support shall include the following activities:

- Attendance at public meetings, briefings & technical meetings to provide site updates.
- Review of presentation materials.
- Technical support for presentation of draft and final Responsiveness Summary, Proposed Plan, and Record of Decision.
- Preparation and review of draft and a final Feasibility Study addendum (if required), based on the final ROD adopted for this site, and covering issues arising after finalization of the basic RI/FS documents.

Task 14 Work Assignment Closeout

Upon notification from EPA, that the technical work under the work assignment is complete, the contractor shall perform the necessary activities to close out this work assignment in accordance with contract requirements.

14.1 Work Assignment Closeout Report (WACR)

The contractor shall prepare a Work Assignment Closeout Report (WACR). The WACR shall include all LOE by P-level and costs in accordance with the Work Breakdown Structure. The contractor shall prepare the WACR in the POI system.

14.2 Document Indexing

The contractor shall organize the work assignment files in its possession in accordance with the current approved EPA file index structure [e.g., Administrative Record Index, EPA Superfund Site File Index, and/or ARCS Guidelines for Closeout of Work Assignments (June 1991)]. For the Superfund program, Section 113(k) (1) of CERCLA, as amended by SARA, requires EPA to establish an Administrative Record (AR) that contains all of the information considered by the Agency in selecting a response action. The AR for the selection of a remedial action or response decision must be made available for public inspection at the commencement of the remedial investigation phase (i.e., when the RI/FS work plan is approved). The format to be used in compiling ARs is outlined in a memorandum from Don R. Clay, former Assistant Administrator, OSWER, entitled *"Final Guidance on Administrative Records for Selecting CERCLA Response Actions,"* dated December 3, 1990.

14.3 Document Retention/Conversion

At the completion of the assignment, the contractor shall submit one copy of the site files and major deliverables in electronic format (Word, Excel, and PDF, as appropriate) to the EPA Records Manager.

Attachment 1
Summary of Major Submittals for Remedial Investigation/Feasibility Study
Cabo Rojo Ground Water Contamination Site, ("the Site")

TASK	DELIVERABLE	Number of Copies	DUE DATE (calendar days)
1.2	Scoping Meeting Minutes	3	5 days after scoping meeting
1.4	Updated RI/FS Work Plan and Draft Budget	4	45 days after scoping meeting
1.5	Final RI/FS Work Plan and Budget	4	15 days after conclusion of negotiations
1.7	Draft Quality Assurance Project Plan (QAPP)	3	15 days after receipt of EPA review comments on draft RI/FS work plan
1.7	Final Quality Assurance Project Plan (QAPP)	3	15 days after receipt of EPA review comments on draft QAPP
1.8	Draft Health and Safety Plan (HASP)	3	15 days after receipt of EPA comments on draft RI/FS work plan; to be submitted with draft QAPP
1.8	Final Health and Safety Plan (HASP)	3	15 days after receipt of EPA review comments on draft HASP; to be submitted with final QAPP
1.10	Meeting Minutes	3	5 days after each meeting
1.13	Pathways Analysis Report	2	TBD as finalized in approved work plan performance schedule
2.1	Community Interview Questions	3	TBD as finalized in approved work plan performance schedule
2.2	Draft Community Relations Plan	3	TBD as finalized in approved work plan performance schedule
2.2	Final Community Relations Plan	3	14 days after final comments from EPA on draft CRP
2.3	Public Meeting Transcripts	2	14 days after each public meeting
2.4	Fact Sheets	2	10 days prior to each public meeting
2.6	Public Notices	2	7 days prior to each public meeting
2.8	Site Mailing List	3	14 days after approval of final CRP; updates 7 days after each public meeting
2.9	Responsiveness Summary Support	3	21 days after public meeting
5.3	Data Validation Report	3	21 days after validation of all analytical data
6.4	Data Evaluation Report	5	TBD as finalized in approved work plan performance schedule
7.1	Draft Baseline Human Health Risk Assessment Report	3	30 days after approval of Pathway Analysis Report
7.1	Final Baseline Human Health Risk Assessment Report	3	14 days after receipt of EPA review comments on draft HHRA

Attachment 1
Summary of Major Submittals for Remedial Investigation/Feasibility Study
Cabo Rojo Ground Water Contamination Site, ("the Site")

TASK	DELIVERABLE	Number of Copies	DUE DATE (calendar days)
7.2	Screening-Level Ecological Risk Assessment Report	3	45 days after completion of field investigation
7.2	Draft Baseline Ecological Risk Assessment Report	TBD	TBD upon implementation into this work assignment
7.2	Final Baseline Ecological Risk Assessment Report	TBD	TBD upon implementation into this work assignment
8.1	Results of Treatability Literature Search	2	TBD and as finalized in approved work plan performance schedule
8.2	Draft Treatability Study Work Plan Addendum	3	TBD upon implementation into this work assignment
8.2	Final Treatability Study Work Plan Addendum	3	TBD upon implementation into this work assignment
8.4	Treatability Study Report	3	TBD upon implementation into this work assignment
9.1	Draft Remedial Investigation (RI) Report	6	90 days after completion of field investigation
9.2	Final Remedial Investigation (RI) Report	6	30 days after receipt of EPA review comments
10.1	Draft Remedial Alternatives Technical Memorandum	6	TBD as finalized in approved work plan performance schedule
11.1	Draft Remedial Alternatives Evaluation Memorandum	6	TBD as finalized in approved work plan performance schedule
12.1	Draft Feasibility Study Report	6	45 days after submission of Remedial Alternatives Evaluation Memorandum
12.2	Final Feasibility Study Report	6	30 days after receipt of EPA review comments
14.2	Document Retention/Conversion	3	Within 60 days after EPA notification of WA completion

ATTACHMENT 2
"GREEN REMEDIATION" PRACTICES

This attachment describes EPA Region 2's current basic guidelines for the contractor's evaluation and implementation of "Green Remediation" practices in the performance of remedial activities under work assignments issued for this contract. In the performance of these remedial activities, the contractor shall, to the extent practicable, explore and evaluate the use of:

Clean Air, through the use of cleaner technology and engines, cleaner fuel and cleaner diesel control technology on all diesel equipment used at sites during the remedial work. Clean diesel technologies are preferred, and alternative fuels such as biodiesel or natural gas-powered vehicles should also be considered. The contractor shall use alternative fuels, of at least a B20 blend or higher, on all on-site diesel equipment where these fuels are available within a reasonable distance from the site. The contractor shall employ the most efficient emission control technology for reducing particulate matter (PM) emissions on non-road and on-road diesel powered equipment used at a site. The contractor shall use cleaner engines, which include non-road engines meeting Tier II or cleaner standards and on-road engines meeting 2004 "On-Highway Heavy Duty Engine Emissions Standards" or cleaner.

Renewable Energy Sources, when conducting work related to selection of a cleanup remedy, constructing a cleanup remedy, and upgrading or otherwise improving an existing cleanup remedy. These sources of renewable energy can include solar, wind, and biofuels. Examples of renewable energy technologies include photovoltaic panels, wind turbines, digesters, gasifiers, and microturbines. As part of evaluating renewable energy sources and technologies, the contractor shall perform cost analyses that compare the energy costs from renewable sources to costs from traditional electricity sources provided by local utilities, over the expected life of the cleanup remedy. The contractor shall also perform evaluations of the emissions prevented as a result of using renewable energy sources versus traditional energy sources provided by local utilities. Finally, the contractor shall evaluate the costs of purchasing "green power" from organizations that offer such green power within the state where the site is located.

"GreenScapes," as a cost-efficient and environmentally friendly solution for site landscaping. The "Greenscapes" concept has been designed to help preserve natural resources and prevent waste and pollution, and encourages practitioners to make more comprehensive decisions regarding waste generation and disposal and their associated cost and environmental effects on land, water, air, and energy use. "GreenScaping" encompasses a set of landscaping practices that can improve the health and appearance of the landscape at a site while protecting and preserving natural resources by reducing or eliminating the amount of waste materials involved in grounds-keeping and the amount of water, pesticides, fuels, oils, and other materials used in landscaping. The practices involved in "GreenScaping" to reduce landscaping costs include: 1) Reducing the production of waste to promote more efficient use of materials; 2) Reusing materials in order to prolong their useful life and delay their recycling and/or final disposal; 3) Recycling to minimize waste generation by recovering and reprocessing usable products that might otherwise be disposed of; and 4) "Rebuying" by making purchases that meet project needs but have a better overall effect on the environment, such as biobased, recycled content, and other environmentally preferable elements. (For more information on "GreenScapes," see www.epa.gov/osw/partnerships/greenscapes/index.htm.)

Industrial Materials Reuse (IMR), involving reusing or recycling byproduct materials generated from industrial processes that can be used as substitutions for raw materials in the manufacture of consumer products, roads, bridges, buildings, and other construction projects. For example, nonhazardous industrial materials, such as coal ash, foundry sand, construction and demolition materials, slag, and gypsum, are valuable products of industrial processes that can be recycled in a variety of diverse applications. These materials have many of the same chemical and physical properties as the virgin materials they replace, and in many cases can even improve the quality of a product. Putting these commodities into productive use can save resources and energy and reduce greenhouse gas emissions. As such, the reuse and recycling of industrial materials is preferred when applicable, and may even present opportunities for revenue generation to offset remedial costs. (For more information on Industrial Materials Reuse, see www.epa.gov/osw/conserve/rrr/imr/index.htm.)

Attachment 3
EPA Region 2 Green Site Assessment and Remediation Checklist

In accordance with EPA's strategic plan for compliance and environmental stewardship, the Agency strives for cleanup programs that use natural resources and energy efficiently, reduce negative impacts on the environment, minimize or eliminate pollution at its source, and reduce waste to the greatest extent possible. The EPA Region 2 Superfund Program supports the adoption of "green site assessment and remediation," which can be defined as the practice of considering all environmental effects of remedy selection and implementation, and incorporating strategies to maximize the net environmental benefit of cleanup actions.1 This definition encompasses each phase of a project, from investigation through remediation and restoration. Opportunities to green a project exist through consideration of the following key variables.2

_ Water Use
_ Land Use
_ Energy Use
_ Air Emissions, Including Greenhouse Gas Emissions
_ Land Use/Ecosystem Impact
_ Materials Use and Waste Produced
_ Long-term Maintenance

An optimal phase in which to start considering these actions is during the Remedial Investigation/ Feasibility Study (RI/FS) phase of a cleanup. Best practices of green remediation can be incorporated throughout the RI/FS phase, and, to maximize sustainability, cleanup and reuse options should be considered early during the planning process, enabling best practices to carry forward to cleanup activities, redevelopment activities, and ultimate land reuse. Incorporation of green remediation strategies into cleanup procurement documents and site management plans helps to open the door for best practices in the field. In accordance with federal procurement policy, selection of cleanup equipment and services must meet a project's performance and cost requirements, while giving preference to green products and providers.3, 4

Best practices of green remediation help ensure that day-to-day operations during all cleanup phases maximize opportunities to preserve and conserve natural resources, while achieving the cleanup's mission of protecting human health and the environment. Each site should incorporate practices addressing core elements of green remediation, with periodic review and update as new opportunities arise. An adaptive approach to managing all phases of a site cleanup enables the site to transition directly into long-term stewardship status. Each site should outline site-specific procedures to, among other things:

_ Reduce air emissions (including greenhouse gas emissions) and energy use,
_ Demonstrate water-quality preservation and resource conservation,
_ Establish near-term improvements to the ecosystem that carry forward into site revitalization, and
_ Reduce material consumption and waste generation.

This checklist is designed to assist EPA contractors in planning for and implementing green practices during the RI/FS.

EPA Region 2
Green Site Assessment and Remediation Checklist
Superfund Remedial Investigation/Feasibility Study Activities

ADMINISTRATIVE

_ Incorporate green remediation practices into the contracting process, as possible

Require contractors follow Region 2's Clean and Green Policy
Suggest contractors consider green remediation best practices during RI/FS

_ Consider future use at beginning of project to guide investigation and remedy selection

Future use may guide type of sampling required; ensure that it is most efficient and green method
Encourage development of renewable energy production facilities on contaminated lands

_ Reporting and Communication

GENERAL ON-SITE OPERATIONS

_ Encourage sustainable practices in trailers/buildings

Utilize existing building for field office if possible
Situate trailer to benefit from existing vegetation
Utilize "green" trailers if possible**6, 7**
Maintain heating and cooling systems
Enhance indoor environmental quality **8**
Optimize operational and maintenance practices to increase efficiency **9**

_ Minimize non-renewable energy consumption
10, 11, 12, 13, 14

Purchase renewable energy supply through local utility programs
Purchase Renewable Energy Credits/Certificates (RECs or Green Tags)
Research potential for Green Pricing Programs and Power Purchase agreements

_ Use environmentally preferable products

Compact Fluorescent Lights (CFL)
Environmentally friendly electronics (e.g., ENERGY STAR) **15**
Require the use of innovative approaches during the RI
Interim and final documents should be submitted in digital rather than hardcopy format, unless otherwise requested by EPA, in an effort to save paper. This is especially applicable to voluminous data reports, such as the validation metadata for laboratory analyses.
Utilize renewable Onsite Generation Systems, e.g., solar photovoltaic (PV), wind turbines, and biomass combustion.
Require contractors to follow guidelines found in the NEDC Model Contract Specification.
Diesel Emission Controls in Construction Projects **5**
Recycled products
Avoid use of pesticides where feasible and follow EPA's Integrated Pest Management Practices **16**

_ Encourage sustainable practices by individuals

Minimize waste **17**
Reuse or recycle waste
Protect and conserve water
Use alternative fuel vehicles (hybrid-electric, biodiesel, ultra-low sulfur diesel) **18**
Carpool **19**
Schedule activities efficiently so as to minimize travel to and from the site

FIELD INVESTIGATIONS

_ Mobilization

Use fuel-efficient / alternative fuel vehicles and equipment **18**
Use existing roadways where available
Provide for erosion and sediment control to minimize runoff into environmentally sensitive areas
Use recycled material for building roadways **21, 22, 23**
Revegetate areas if necessary

_ Demolition of on-site structures

Minimize demolition of structures and buildings
Recycle demolition and construction material as possible **21, 22, 23**

_ Field Screening

Use non-invasive technologies where possible for subsurface characterization to minimize wastes (Electrical Resistivity Tomography, Borehole Radar Tomography, Ground-Penetrating Radar, Seismic Refraction/Reflection, Electromagnetic Survey). **24, 25, 26**

Incorporate systematic planning, dynamic work strategies, and real-time measurements into work plans (TRIAD) to promote efficiency in remedial investigations. **27**

Avoid environmentally sensitive areas and cutting native trees/vegetation when placing trailers and storage areas, and while building access

Use diesel engines that meet the most stringent EPA on-road emissions standards available at the time of project's implementation or utilize EPA or CARB verified emission control technology to reduce PM emissions by a minimum of 85% when technologically feasible on all on-road diesel engines. **20**
Minimize number of field mobilizations
Minimize number of samples sent to laboratories
Use of mobile laboratories
Use of alternate fuel sources

Drilling

Have idle reduction policy and idle reduction devices installed on machinery **28**
Use ultra-low sulfur diesel and/or fuel-grade biodiesel as fuel **29, 30, 31, 32, 33, 34**
Engine Maintenance **36**

Perform routine inspections
Conduct preventative maintenance
Give problems immediate attention
Perform routine cleaning
Use environmentally friendly lubricants if applicable
Decontamination
Place decontamination station away from environmentally sensitive areas
Use secondary containment to avoid cross contamination
Use steam cleaning where allowed by federal/state/or local regulations
Use non-phosphate detergents
Well Installation
Use recycled well materials where possible (well caps, etc.)
Manage use of cement/grout to minimize waste produced
Ensure wells are properly developed to increase efficiency
Waste Management
Use direct-push rig if applicable to minimize drill cuttings
Place drill cuttings back in boring if applicable
Store drill cuttings away from surface water bodies to prevent cross-contamination
Dispose of drill cuttings at recycling facility if possible
Use diesel engines that meet the most stringent EPA Tier non-road emissions standards available at the time of project's implementation or utilize EPA or CARB verified emissions by a minimum of 85% when technologically feasible on all non-road diesel vehicles. **35**

_ Sampling

General practices
Use environmentally friendly PPE if applicable
Use recycled laboratory containers if applicable
Use laboratories which promote green chemistry
Schedule sampling to minimize field visits and shipping
Consider all data needs for any potential future uses

Soil Sampling
Use sampling methods that require smaller amounts of soil to minimize waste
Dispose of waste properly to avoid cross contamination
Recycle soil waste if available

Groundwater sampling
Use passive groundwater samplers where applicable **37, 38**
Use eco-friendly bailers **39**
Use dedicated equipment to minimize waste and cross-contamination
Use remote data collection to minimize mobilizations
Treat and recycle purged water on-site

Surface Water sampling
Choose sampling locations that minimize ecological disturbance
Use dedicated sampling equipment to minimize waste and cross-contamination

TREATABILITY INVESTIGATIONS/FEASIBILITY STUDIES

_ Treatability Investigations (Bench-Scale, Pilot-Scale)
_ Analysis of Alternatives in the FS and Green Remediation Best Management Practices (BMPs)

Evaluate "net environmental benefit as part of the nine criteria review process **2**
Decontaminate equipment away from surface water body to avoid contamination due to runoff
The evaluation of laboratory sub-contractors should include their commitment to green chemistry. The purpose is to reduce the amount and toxicity of chemicals used and required to be disposed. **40, 41**
Consider future use of site in determining the short and long-term effectiveness of the remedy
If one remedy has a vendor within the state but another remedy will require shipping equipment from another region, then the first remedy is more easily implementable AND may have a lower environmental footprint (through reduced transportation).
Evaluate energy efficiency (amount of energy necessary to remove one pound of contaminant) of each alternative over the projected lifecycle of the alternative.
Evaluate water intensity (amount of water necessary to remove one pound of contamination) **2**
Focus on minimizing high quality fresh water use
Assess the use of reclaimed water where applicable, e.g., for irrigation
Use native vegetation that requires little or no irrigation
Assess the best estimate of the cost of the energy projected out 30 years
Evaluate water intensity (amount of water necessary to remove one pound of contamination) **2**
Focus on minimizing high quality fresh water use
Assess the use of reclaimed water where applicable, e.g., for irrigation
Use native vegetation that requires little or no irrigation
Consider Green Remediation Best Management Practices for site restoration
Low-Impact Development (LID) - stormwater management **43**
Ecorestoration (increased wildlife habitat, increased carbon sequestration, protection of water resources, etc).
Greenscaping **44**
Encourage development of renewable energy production facilities on contaminated lands
Evaluate soil intensity of each alternative (amount of soil necessary to be displaced or disturbed to remove one pound of contaminant) **2, 42**
Incorporate green remediation best practices for each remedy considered as part of cost evaluation
Incorporate green remediation best practices for each remedy considered as part of cost evaluation
Analyze the feasibility of alternate energy sources for the required energy, e.g., solar, wind, biodiesel, etc.
Evaluate low-energy remedial alternatives, e.g., MNA, phytoremediation, micro-bioremediation, etc.; low energy use will be one of the factors weighed against the projected time for remediation
Minimize use of fertilizer, pesticides, herbicides, and other chemicals to prevent nutrient loading and toxicity impacts to nearby water bodies
Evaluate material intensity of each alternative (amount of raw materials extracted, processed, or disposed for each pound of contaminant treated) **2**
Minimize use of fertilizer, pesticides, herbicides, and other chemicals to prevent nutrient loading and toxicity impacts to nearby water bodies

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